Trapping and Coded Wire Tagging of Wild Coho Salmon Juveniles in the Upper Pitt River System, 1979 and 1980

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by

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ABSTRACT

Schubert, N.D. and A.Y. Fedorenko. 1985. Trapping and coded wire tagging of wild coho salmon juveniles in the upper Pitt River system, 1979 and 1980. Can. MS Rep. Fish. Aquat. Sci. 1815: 78 p.

Coho juveniles from the upper Pitt River system were captured and coded wire tagged during the fall of 1979 and 1980. A total of 62,380 age 0+ coho and 19,045 age 1+ coho were released with tag codes 02 16 62 and 02 16 60 respectively in 1979, and a total of 70,460 age 0+ coho and 15,413 age 1+ coho were released with tag codes 02 18 03 and 02 18 02 respectively in 1980. Mean size of tagged age 0+ coho ranged from 53 mm to 56 mm and 1.6 g to 1.9 g; tagged age 1+ coho averaged 82 mm to 83 mm and 6.6 g to 6.8 g.

Key words: upper Pitt River, coho salmon, coded wire tagging.

Résumé

Schubert, N.D. and A.Y. Fedorenko. 1985. Trapping and coded wire tagging of wild coho salmon juveniles in the upper Pitt River system, 1979 and 1980. Can. MS Rep. Fish. Aquat. Sci. 1815: 78 p.

Au cours de l'automne de 1979 et de 1980, des saumons cohos juvéniles ont été capturés dans les eaux d'amont du système de la rivière Pitt, puis munis d'étiquettes métalliques codées. Au total, 62,380 poissons de moins d'un an et 19 045 individus d'un an ont été étiquetés et relâchés (codes 02 16 62 et 02 16 60 respectivement) en 1979; en 1980, ces nombres s'élevaient respectivement à 70,460 et 15,413 (codes 02 18 03 et 02 18 02, respectivement). En moyenne, les poissons de moins d'un an mesuraient de 53 mm à 56 mm et pesaient de 1.6 g à 1.9 kg; les cohos d'un an mesuraient 82 mm à 83 mm et pesaient 6.6 kg à 6.8 kg.

Mots-clés: rivière Pitt, saumon coho, étiquetage au moyen de fils metalliques codés.

INTRODUCTION

A coho salmon coded wire tagging (CWT) study was conducted during the autumns of 1979 and 1980 in the upper Pitt River (Fig. 1), a large Fraser River tributary draining a mountainous watershed north of Haney, B.C. This study was one of several recently initiated in the Fraser River system to determine, through the coast-wide mark recovery program, the exploitation rate, catch distribution and survival rate of specific coho stocks (Schubert 1982b, 1983; Fedorenko and Cook 1982; Cook MS 1983; Hutton et al. MS 1983).

The upper Pitt River was selected for study for three reasons. First, although Department of Fisheries and Oceans (DFO) field staff have monitored upper Pitt River coho escapements for a number of years, survey effort has been inconsistent and the documentation of life history characteristics and spawning and rearing distributions has been poor. The present study was designed, therefore, to document coho biological characteristics as well as exploitation rates and harvest distributions. Second, previous coded wire tag assessment of wild Fraser River coho salmon had focused primarily on stocks from low gradient, lowland systems (Schubert 1982b; Fedorenko and Cook 1982). The upper Pitt River was selected for study to determine whether a stock from a relatively high gradient, glacial system had similar exploitation and harvest distribution patterns. Finally, since upper Pitt River coho formed a major component of the Fraser River coho resource, assessment of this stock received a high priority.

The upper Pitt River system was surveyed during 1977 and 1978 to record aspects of salmonid life histories and distributions (Schubert 1982a). This survey indicated that high spring discharges and persistent snow could limit the effectiveness of an emigrant coho smolt CWT study. Instead, a more effective program involving the trapping and coded wire tagging of rearing coho salmon juveniles was implemented during the autumns of 1979 and 1980.

This report documents the results of the 1979 and 1980 programs, including catch by species, numbers of coho released with CWT's and coho age and length characteristics. Also described is a field technique useful in discriminating between cohabiting yearling (age 1+) and underyearling (age 0+) coho juveniles. An analysis of adult exploitation and survival rates and catch distributions will be published when catch and escapement data are finalized.

STUDY AREA DESCRIPTION

The upper Pitt River arises in the Coast Mountains near Isosceles Peak (1710 m elevation) and flows in a southerly direction for approximately 52 km before entering the north end of Pitt Lake (Fig. 1). The river forms the main drainage system for the interior portion of Garibaldi Park, which comprises over one-half of the 780 km^2 watershed. The watershed is typically glaciated and mountainous, varying in elevation from 30 m ro 2,700 m. Less than 10% of the watershed lies below 300 m.

The upper Pitt River flows for much of its length in a braided, shifting channel across a broad, flat bottomed valley bounded by steep mountains. The river is passable to adult salmonids throughout the lower 40 km; however, it is constrained by two bedrock canyons, locally termed the first and second canyons, located approximately 17 km and 22 km respectively upstream from Pitt Lake, and by a narrowing of the valley, locally termed the third canyon, approximately 28 km upstream. The main river is relatively steep, with an average gradient of approximately

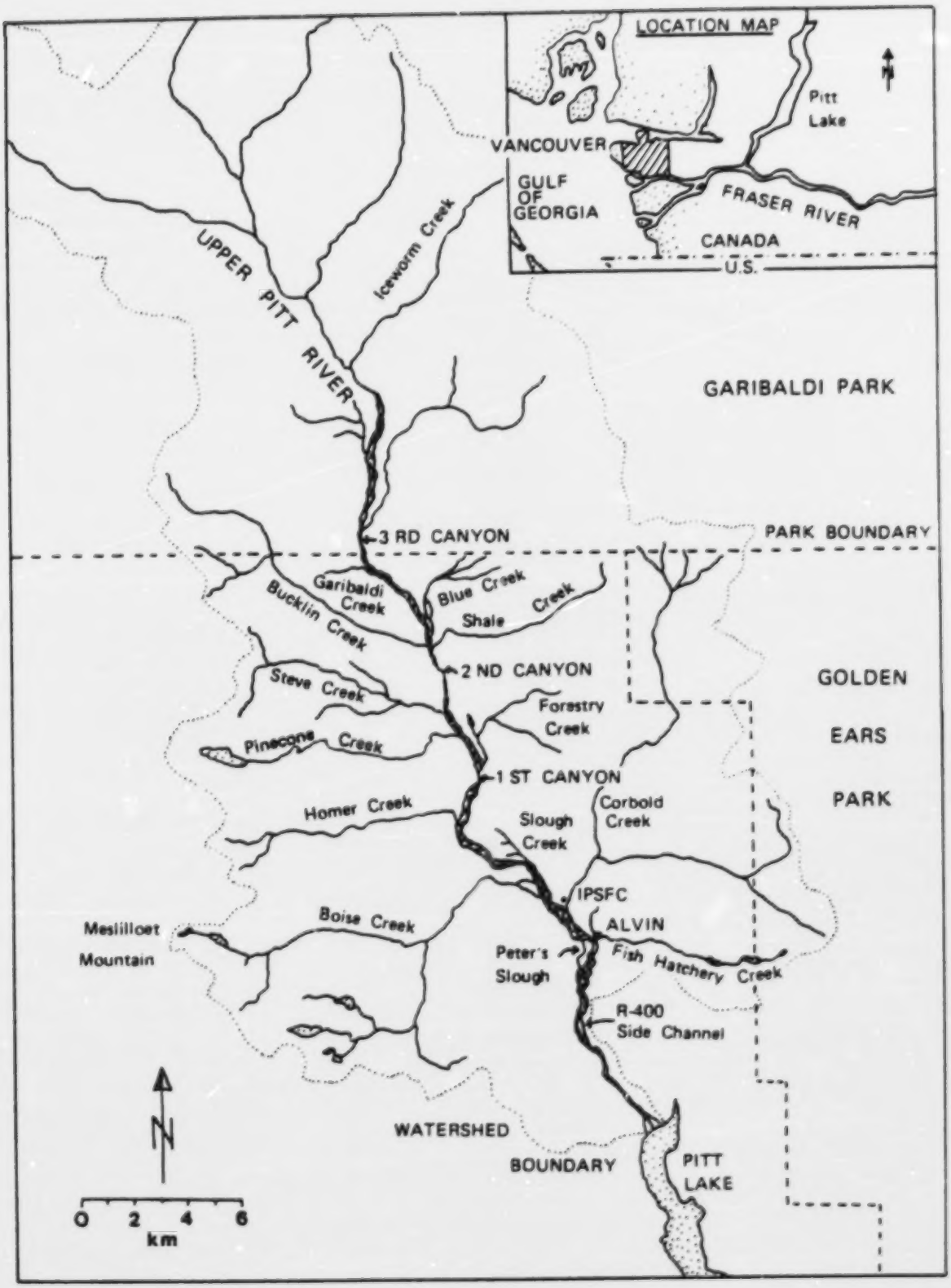

Fig. 1. Study area location map.

0.7%, resulting in a river morphology characterized by long rapids, riffles and frequent deep pools. Tributary streams enter from steep side valleys and may flow for several kilometers across the upper Pitt River flood plain prior to entering the main river. The largest tributaries are Boise and Corbold creeks; however, a number of small, often spring-fed tributaries which drain benchland adjacent to the upper Pitt River mainstem provide important salmonid habitat.

The upper Pitt River hydrograph reflects a dominant summer glacial melt modified by fall and spring precipitation inputs. Daily discharges averaged approximately 54 cubic meters per second (cms) over a 14-year period ending in 1965 (Appendix 1). Maximum and minimum mean monthly discharges generally occurred in July (115 cm) and March (14 cm) respectively (Fig. 2). Violent flow fluctuations frequently occur during the fall as a result of high intensity rainfall coupled with snow melt at the middle and lower elevations. An extreme example occurred on November 2 and 3, 1955 when discharges increased from 34 cms to 597 cms over a 24-hour period. These short duration discharge events result in frequent channel shifts due to the combined effects of bank erosion at peak flows and bedload deposition when flows recede. The International Pacific Salmon Fisheries Commission (IPSFC) estimated the bedload transport in excess of 0.36 kg/sec/m width, over 45 times that occurring in the Adams River (Cooper MS 1967). These frequent channel shifts limit the value of mainstem spawning and rearing habitat.

Development in the upper Pitt River watershed has been limited by the remoteness of the area (inaccessible by road) and by the establishment of Garibaldi Provincial Park in the upper watershed in 1920. The only significant human activity has been forest harvesting. The Blackstone Logging Company began low elevation harvesting in 1941, and B.C. Forest Products (BCFP), which currently maintains a network of roads and operates a logging camp at Alvin (Fig. 1), has development plans through the next 25 years. The B.C. Forest Service (Corrections Branch)

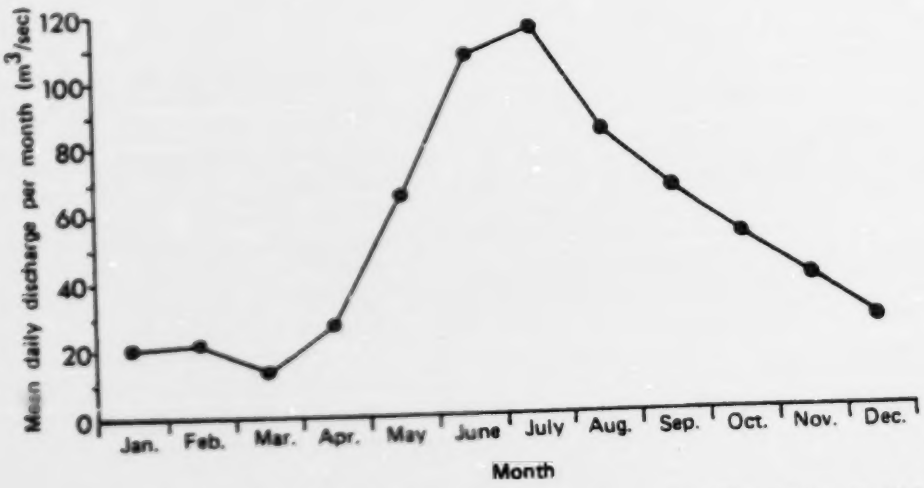

Fig. 2. Mean daily discharge by month in the upper Pitt River at the first canyon, 1952 - 1965.

conducted an alder thinning program between 1977 and 1983.

The upper Pitt River has supported all five species of Pacific salmon (Appendix 2), as well as populations of steelhead trout, cutthroat trout, and Dolly Varden char. In recent years, only sockeye and coho have been present in significant numbers. Pink salmon have not been reported since 1961 and chum salmon have been reported irregularly since 1959. Sockeye escapements since 1951 averaged 21,800, with a maximum of 49,000 recorded in 1952 (Appendix 2). Coho escapements averaged 4,900 since 1951, with a maximum of 35,000 reported in 1971. Chinook escapements averaged 900 since 1951, with a maximum of 7,500 reported in 1971. A significant steelhead run is present in the system; however, it has not been enumerated since 1957.

The Department of Fisheries operated a salmon hatchery on Fish Hatchery Creek from 1917 until the hatchery program was abandoned in 1936. The purpose of this facility was to improve, through artificial incubation and short-term rearing, the egg-to-fry survival of sockeye salmon in order to offset the effects of overfishing. The hatchery, with a capacity of approximately seven million eggs, was primarily a sockeye facility, although up to 235,000 coho and 180,000 Kamloops trout were produced in some years. In addition to the hatchery production of upper Pitt River stocks, up to 3.6 million eyed eggs or fry were annually transplanted into the system from other hatcheries (Aro 1979). These transplants occurred almost every year between 1884 and 1917, and were frequent after that time if the hatchery could not be filled to capacity with local stocks. Sockeye stocks transplanted to the upper Pitt River or Pitt Lake included those from Harrison River, Weaver Creek, Big Silver Creek, Douglas Creek, Birkenhead River, Scotch Creek, Tappen Creek, Adams River, and Sweltzer River. Coho stocks were transplanted from the Nicomekl, Serpentine and Salmon rivers; chinook stocks were transplanted from the Harrison River; and Kamloops trout were transplanted from the Nicola system.

A sockeye hatchery was re-established on Corbold Creek in 1960 by the IPSFC. This five million egg facility was intended to supplement the production of fry in the upper Pitt River and halt the decline arising from the deterioration of the natural spawning areas and from overharvesting in fisheries targeting on other more productive Fraser River sockeye stocks.

DESCRIPTION OF TRAPPING SITES

Study sites in the upper Pitt River system were selected on the basis of apparent coho size and abundance (as determined during the preliminary survey), extent of available rearing habitat, and accessibility and do not, therefore, represent a comprehensive catalogue of major rearing areas. The study sites are described below and are detailed in maps developed from aerial photographs and ground observations (Appendix Figures 1 through 7). Distances upstream from Pitt Lake are bracketed, as are local names for streams without official names.

Unnamed Side Channel (R-400 Side Channel) (4 km). This ephemeral channel originates on the east side of the upper Pitt River at the lower bridge crossing. The channel arises from seepage flow in a shallow, marshy area created by gravel removal operations, then flows for 1 km in a channel adjacent to the main river. Rearing densities recorded during midsummer in 1979 were high; however, rearing in this area is seasonal because the channel dewaters when Pitt River flows decline in early fall.

Peter's Slough (6.5 km). Referred to in early records as Charles

Peter's Slough (Rodd 1928), Peter's Slough is a 2 km long side channel located on the west side of the upper Pitt River opposite Alvin (Appendix Fig. 1). The upper part of the channel has a width of approximately 6 m, a compacted gravel substrate, and is characterized by long, shallow riffles, isolated deep pools, log jams, and stable, well vegetated banks. The lower part of the channel has frequent mainstem intrusions and, as a result, the banks are subject to erosion, flows are greater and the substrate consists of finer, shifting gravel.

Fish Hatchery Creek (8.5 km). Fish Hatchery Creek is a steep mountain stream which flows west for approximately 7.5 km, entering the upper Pitt River at Alvin (Appendix Fig. 2). BCFP maintains a small dam in the upper reaches to draw water and generate electricity. Fish Hatchery Creek is accessible to salmonids only in the lower 200 m, where the stream flows across the Pitt River flood plain; however, a small tributary which joins the creek 150 m upstream is accessible for approximately 1.5 km. This tributary is characterized by a series of beaver dams which create a large, deep marsh with a thick mud bottom and rooted aquatic vegetation throughout. A small stream at the head of the marsh provides the only apparent spawning habitat in this tributary.

Boise Creek (11 km). Boise Creek is a major Pitt River tributary which arises near Meslilloet Mountain and flows east for approximately 15.5 km before entering the upper Pitt River (Appendix Fig. 3). The creek flows from an impassible canyon onto the Pitt River flood plain approximately 2.3 km upstream from its confluence with the upper Pitt River, then splits into two main branches (North and South Boise creeks).

North Boise Creek is the larger branch, with an average wetted width of 15 m. Prior to 1981, North Boise Creek flowed in a series of rapids and pools within a single, well defined channel; however, winter floods in 1980/81 caused a large log jam to form behind a disused logging bridge near the creek mouth. The deposition of bedload behind this log jam caused the creek to break through both banks of the previous stream bed. As a result, North Boise Creek now flows through a predominantly alder forest and has yet to establish a permanent channel. A small groundwater fed tributary joins North Boise Creek approximately 1.8 km upstream from the Pitt River. This tributary, which has a width of 3 m and a length of approximately 0.5 km, is one of the most heavily utilized coho spawning areas in the Boise Creek system.

South Boise Creek consists of three small channels which join approximately 1.4 km upstream from the Pitt River, forming a 6 m wide channel with a rapids/pool stream form and a coarse gravel substrate. The three upper channels arise at a large log jam and receive only seepage flow at normal discharges. A small groundwater fed tributary joins approximately 1 km upstream. This tributary is slow moving, and has a mud substrate.

Unnamed Channels (Boise Flats) (11.4 km to 12 km). Boise Flats refers to an aggregate of several small channels which flow across benchland on the west side of the upper Pitt River immediately upstream from the North Boise Creek confluence (Appendix Fig. 3). These channels are characterized by isolated pools, long, shallow riffles, and a channel width of 3 m or less.

The smallest channel in the Boise Flats aggregate is a 50 m long side channel located at the second bridge crossing of the upper Pitt River, approximately 11.5 km upstream. A second side channel flows in a densely foliated channel for 1.5 km, re-

entering the upper Pitt River mainstem approximately 12 km upstream. The final channel is a small seepage and groundwater fed tributary which flows in two channels which join before entering the mainstem approximately 11.4 km upstream.

Unnamed Creek (Slough Creek) (12.5 km). Slough Creek consists of two main branches which drain a broad 1.5 km long section of flood plain located on the east side of the upper Pitt River (Appendix Fig. 4). The stream is characterized by frequent beaver dams, extensive instream debris, rooted aquatic vegetation, and a primarly mud substrate. Gravel deposits are confined to scattered riffle sections. Flows are derived primarily from groundwater or seepage, although ephemeral tributaries develop on the adjacent mountain face during heavy rainfall events.

Unnamed Creek (Forestry Creek) (17 km). Forestry Creek flows west for approximately 4.5 km before entering the upper Pitt River immediately above the first canyon (Appendix Fig. 5). In the lower 1.5 km, the creek flows across the upper Pitt River flood plain and is characterized by a series of straight, shallow riffles and a compacted gravel substrate. A small tributary, which drains an extensive 1.5 km long marsh, joins the creek approximately 1 km upstream. Coho utilization of this tributary in 1979 and 1980 was limited by an impassible beaver dam.

Blue Creek (24 km). Blue Creek flows in a westerly direction for approximately 7 km, entering the upper Pitt River 1.5 km north of the second canyon (Appendix Fig. 6). The creek flows from a steep mountain slope onto the Pitt River flood plain, then flows parallel to the main river for the lower 2.5 km. Bedload accumulation at the mountain/flood plain interface produces a number of small channels which coalesce into two main branches which then meander for 1.4 km through a thick cedar/spruce/alder forest. At approximately 1.1 km upstream from the upper Pitt River, the main branches form a single channel which is characterized by a rapids and pools stream form, a coarse gravel substrate and a generally straight channel with extremely stable banks.

The east branch is a deep, slow moving run for most of its length, with a typically sand and mud substrate and frequent dead falls. The west branch has a width of approximately 5 m and is characterized by a riffle/pool stream form, a fine gravel substrate, and frequent instream debris. The west branch feeds a number of large beaver ponds, some of which drain, through seepage flow or small channels, directly into the Pitt River.

A small tributary joins the west branch approximately 2.3 km from the Blue Creek mouth. This low gradient tributary, accessible to salmon for approximately 1.5 km, has an average width of 1 m, scattered gravel deposits and a thick overgrowth of deciduous shrubs. Although apparently ephemeral in nature, this tributary is often heavily utilized by coho spawners.

Unnamed Creek (Garibaldi Creek) (26.5 km). Garibaldi Creek is a small stream which flows for approximately 1 km along a narrow alluvial bench on the west side of the upper Pitt River (Appendix Fig. 7). The stream is characterized by a series of beaver dams bordered by tall grasses. Gravel deposits are scattered and the stream is impassible beyond 1 km upstream.

A small side channel which flows parallel to the upper Pitt River adjacent to Garibaldi Creek was also trapped during this program; however, subsequent mainstem shifts have changed this area into a mainstem channel.

METHODS

FISH CAPTURE

Minnow Trapping

Minnow traps baited with frozen chum salmon roe were the only effective capture technique used in both 1979 and 1980. Trapping was conducted throughout the periods September 5 to November 1, 1979 and September 4 to October 18, 1980. Up to 200 traps were set daily in areas of slow to moderate current and adequate cover, such as in log jams, among rooted aquatic plants and submerged debris, and under overhanging banks. In areas of high fish abundance but limited cover, capture effectiveness was frequently improved by providing artificial cover such as tree or shrub branches.

Captured fish were removed from the traps at least twice and as often as five times each day, sorted to species and enumerated. All coho juveniles were transported in 23 liter plastic buckets to nearby pens (described below) where they were held for coded wire tagging. All other species were released at the capture site, except trout subsamples which were retained for species identification.

Each tributary area was intensively trapped in isolation from other areas. Traps were baited after each check and were moved frequently in response to declining catch levels. When all known rearing areas within a tributary had been trapped, trapping was halted and the tagged juveniles were returned to that tributary area.

Beach Seining

The use of beach seines (1.8 m x 15 m), constructed from 1.2 cm mesh with a 0.6 cm mesh bunt, was attempted during 1979 in side channel areas which, due to shallowness and lack of cover, were not suited to minnow trapping; however, coho juveniles tended to take refuge, making seining ineffective. As a result, this method was abandoned.

JUVENILE COHO HOLDING

Prior to tagging, all coho juveniles were held in instream pens constructed from 0.9 m x 1.8 m plastic (ABS) pipe frames and 4.8 mm mesh marquisette netting. Snap-on plastic covers provided shade and protection from avian predators. Holding sites were selected in each discrete trapping area on the basis of four criteria: protection from turbulence during freshets; proximity to trapping areas; the presence of an adequate supply of clean, oxygenated water at low flows; and ease of access. During 1979, the pens were constantly monitored during periods of changing flows, and shifted as required to maintain adequate water depth. In 1980, monitoring requirements were considerably reduced when floats (boat-bumpers) were attached to the ABS frame uprights, permitting the pens to float during high discharges.

Daily catches were graded by size into separate pens in order to minimize cannibalism. Pen loading densities were loosely based on those recommended by McNeil and Bailey (1975), but were modified on the basis of local conditions and fish behavior. Mortalities were enumerated and removed daily. In 1979, all fry held for two days or more were fed a commercial moist food preparation twice daily; feeding was discontinued in 1980 due to stresses associated with the virtually continuous CWT operations.

CODED WIRE TAGGING

Tagging Target

In order to establish a CWT application target for the upper Pitt River study, it was first necessary

to estimate the fry-to-adult survival rate, as well as the marine fishery recovery level required to meet the study objectives.

Preliminary data from previous CWT assessments of coastal B.C. wild coho stocks (Argue and Armstrong 1977; Armstrong and Argue 1977; Argue et al. 1979; de Hrussoczy-Wirth 1979) suggested that the release of 30,000 coded wire tagged coho smolts would be sufficient to meet study objectives; however, no information was available concerning coho fry. In order to establish a CWT application target for the upper Pitt River study, fry-to-smolt survivals were projected from published and unpublished literature sources, summarized in Appendix 3. This review indicated that survival assessments in Carnation Creek, subsequently published by Holtby and Hartman (1982) and Tschaplinski and Hartman (1982), were most appropriate to the coho life history patterns and habitat parameters of the upper Pitt River system. The survival of Carnation Creek coho fry through their first winter averaged 33% (range 17% to 63%) (Holtby and Hartman 1982), with higher survivals ranging from 61% to 72% reported for fry overwintering in small tributaries and sloughs (Tschaplinski and Hartman 1982; Bustard and Narver 1975). Since trapping activities in the upper Pitt River would focus on fry rearing in small tributaries and sloughs, an intermediate survival rate was assumed and a tagging target of 65,000 was adopted.

A rigorous tag application target was not developed for age 1+ coho due to expected low abundances. All age 1+ coho were tagged.

Age Class Separation

Preliminary surveys during the summers of 1979 and 1980 indicated that up to 30% of the juvenile coho population in the upper Pitt River was age 1+, a situation strikingly different from other southern B.C. coastal streams where most age 1+ individuals emigrated by early summer (Fedorenko and Cook 1982; Schubert 1982b, 1983, 1984). In view of possible brood year specific genetic and behavioral differences which could bias subsequent analyses, all coho juveniles captured during the study were sorted by age class in order to tag each brood year with a unique tag code. Initially, sorting was based on body size, using a 67.5 mm fork length cutoff between age classes (from preliminary survey data); however, the accuracy of this technique was limited for two reasons. First, considerable overlap in body size existed by late summer between the faster growing age 0+ coho and slower growing age 1+ coho, resulting in a substantial and progressively increasing sorting error when a "best choice" cutoff criterion was used. Second, since apparent growth rates differed among study areas, a "best choice" cutoff point calculated from pooled preliminary data was not applicable to all areas.

In an attempt to improve sorting accuracy, we investigated the use of eye size as a second morphological feature for use in conjunction with body size. Robinson (MS 1976) investigated the relationship between eye size and age in Great Central Lake sockeye fry. He reported that eye size at a given fork length was a function of age, the older individual having the larger eye, and recommended the use of eye size as a field sorting technique when considerable overlap exists in the length-frequency distribution of cohabiting cohorts. Since field observations suggested that a similar relationship existed between eye size and age in upper Pitt River coho juveniles, both body and eye size were used for the duration of the study. Sorting was a subjective process which considered both absolute fork length and eye size in relation to fork length. The length-frequency distribution deve-

loped during the preliminary survey was used as a general guide, but a fixed fork length cutoff was not used. Instead, when both eye and body size evaluations gave ambiguous results, sorting was based on a fixed eye diameter cutoff of 5.5 mm.

The effectiveness of the above technique relative to the "best choice" cutoff technique using either an eye diameter or fork length cutoff point was assessed by measuring eye diameter as well as fork length and age in all tag lot samples taken after October 10, 1979. Eye diameter was defined as the greatest distance between the margins of the scleral cartilage on a line along the vertical axis of the cornea. Diameter was measured to the nearest 0.1 mm using a dial caliper.

Tagging Procedure

The CWT equipment and machine maintenance procedures used during the study were similar to those described by Armstrong and Argue (1977). Tagging occurred between September 6 and November 1, 1979, and between September 5 and October 20, 1980. In 1979, tagging commenced following the cessation of trapping in each tributary; in 1980, trapping and tagging operations were coincident, with all tagged fish held in pens until trapping in that area was completed.

On each tagging day, tag implant location was checked for each tag lot by bisecting the skull of a tagged coho with a scalpel along the median plane. If the tag was not in the preferred position in the cartilaginous wedge of the skull (the chondrocranium), implant depth was adjusted and the procedure repeated until tag placement was correct. Following this check, the remaining fish were tagged.

During the tagging operation, the fish were anaesthetized using a stock Tricaine Methane Sulphonate (TMS) solution of 7.5 g per liter of water which was further diluted, as conditions dictated, in a 7.5 liter plastic basin. The juveniles were sorted by age (using fork length and eye size criteria) and each group was assigned separate nose molds, implant depths and tag codes. All coho juveniles with a fork length greater than 45 mm were tagged, with the exception of any diseased and damaged fish which were noted and excluded from tagging. The fish were then marked by adipose fin removal, tagged, and passed through the quality control device (QCD) to ensure the tag was present. A random sample of 200 to 800 coho was removed from the recovery bucket throughout each tagging operation and retained for 24-hour mortality and tag retention assessments. On occasion, this step was omitted due to problems with bears or flood conditions. Any coho without pins were retagged, and the tag lot totals were adjusted to reflect the numbers released with tags. All other tagged fish were either immediately transported to the original trapping area and released or held until the cessation of trapping, then transported and released.

Tag Codes

Four unique tag codes were used for age 0+ and age 1+ coho during 1979 and 1980, and the same codes were applied at all sites in each year. During 1979, age 0+ (1978 brood) and age 1+ (1977 brood) coho were tagged with codes 02 16 62 and 02 16 60 respectively. During 1980, age 0+ (1979 brood) and age 1+ (1978 brood) coho were tagged with codes 02 18 03 and 02 18 02 respectively.

BIOLOGICAL SAMPLING

Tag Group

Age 0+ and 1+ tag groups in each area were subsampled to determine both the reliability of age discrim-

ination as well as the average size at release. At each site, 25 juveniles from each tag group were randomly sampled immediately prior to release. A scale smear was taken with a scalpel from the "preferred region", as defined by Clutter and Whitesel (1956); nose-fork length was measured to the nearest mm, and eye diameter to the nearest 0.1 mm. Mean wet weight (± 0.1 gram) was determined by weighing the sample in aggregate on an Ohaus triple beam balance.

Tributary Monitoring

North Boise and Slough creeks were monitored on a weekly basis during the periods August 2 to November 14, 1979 and August 6 to November 19, 1980 to assess trends in juvenile coho abundance, adipose mark incidence, age composition and size. These creeks were selected for assessment because of their proximity to each other and apparent differences in habitat type. North Boise Creek is characterized by a moderate gradient, a gravel substrate and primarily surface water flows. Slough Creek is characterized by a low gradient, a mud substrate and primarily ground or seepage water flows.

Two minnow traps were set weekly at standard sample sites in each tributary. During 1979, standard minnow traps were used; during 1980, fine mesh minnow traps were used to eliminate size selective trapping biases. Catches were sorted by species and enumerated, and all coho juveniles were examined for adipose clips. Up to 50 fry were removed randomly from the daily catch in each stream and anaesthetized in a TMS solution prior to sampling, as described above.

PHYSICAL SAMPLING

In 1979 and 1980, surface water temperatures were recorded, using seven and 31-day Taylor continuous recording thermographs, in the upper Pitt River at the lower bridge crossing (4 km upstream) and in North Boise Creek at a site approximately 150 m from the mouth. In 1980 only, a 31-day Taylor thermograph was installed in Blue Creek approximately 100 m from the mouth. Surface water temperatures were also recorded twice daily at the mouth of Slough Creek and spot temperatures were recorded at all minnow trapping sites using pocket thermometers.

Water levels were recorded twice daily on staff gauges installed at the upper Pitt River and North Boise Creek sites.

RESULTS AND DISCUSSION

FISH CAPTURE

Coho Salmon

1979: A total of 96,845 juvenile coho salmon were captured in 10 major upper Pitt River rearing areas by expending 4,155 trap-days effort over a 57-day trapping period (Table 1a). The total catch included approximately 13,800 coho juveniles which were lost from flooded pens in Garibaldi and Fish Hatchery creeks on October 25, 1979. Only 4,038 coho were subsequently captured in these areas and released with CWT's. The total catch did not include coho juveniles lost in traps molested by black bears. A total of 55 minnow traps were destroyed by bears during 1979 and other traps were regularly disturbed in most areas.

The largest catches occurred in Boise and Blue creeks, which contributed 23% and 17% respectively to the total catch and together accounted for 40% of total trapping effort. The smallest catches occurred in R-400 Side Channel and Forestry Creek, which contributed 1% and 3% respectively to the total catch and together accounted for 10% of the total trapping effort.

Table 1a. Coho minnow trapping results by area in the upper Pitt River system, 1979 and 1980.

Location	Capture period	Days fished[a]	Trap-days effort[b]	Coho catch[c]	Coho catch per trap-day
		1979			
R-400 Side Channel	Sep. 5 - 6	2	160	1,003	6.3
Peter's Slough	Oct. 30 - Nov. 1	3	167	12,682	75.9
Fish Hatchery Creek	Oct. 16 - 24	9	328	8,331	25.4
N. Boise Creek	Sep. 24 - Oct. 3	9	436	9,021	20.7
S. Boise Creek	Oct. 1 - 7	7	449	13,514	30.1
Boise Flats	Sep. 17 - 27	10	579	10,176	17.6
Slough Creek	Sep. 13 - Oct. 29	18	680	13,241	19.5
Forestry Creek	Sep. 10 - 12	3	272	2,913	10.7
Blue Creek	Oct. 7 - 17	11	771	16,443	21.3
Garibaldi Creek	Oct. 21 - 24	4	313	9,521	30.4
TOTAL	-	76	4,155	96,845	23.3
		1980			
Peter's Slough	Sep. 9 - 14	6	371	9,351	25.2
Fish Hatchery Creek	Sep. 5 - 10	6	625	9,027	14.4
N. Boise Creek	Sep. 28 - Oct. 8	10	690	22,207	32.2
S. Boise Creek	Oct. 8 - 11	4	212	5,363	25.3
Boise Flats	Sep. 30 - Oct. 5	6	558	14,030	25.1
Slough Creek	Sep. 20 - 27	8	670	14,998	22.4
Forestry Creek	Sep. 4 - 5	2	229	4,563	19.9
Blue Creek	Oct. 13 - 18	6	916	13,761	15.0
Garibaldi Creek	Sep. 16 - 18	3	285	7,773	27.3
TOTAL	-	51	4,556	101,073	22.2

[a] Includes partial trapping days.
[b] Sum of number of traps fished each day through the trapping period.
[c] Sum of total marked, pretagging mortality and holding mortality, except 1979 Fish Hatchery Creek and Garibaldi Creek data based on minnow trapping totals due to losses during October 25 flood.

Coho catch per trap-day (CPE) averaged 23.3 in 1979, ranging from a low of 6.3 in R-400 Side Channel to a high of 75.9 in Peter's Slough. CPE data, however, are not a reliable index of coho abundance. The measurement of fishing effort in trap-day units is not sensitive to variable frequency of trap checks or to duration of the trapping period, both of which can influence catch. Calculated CPE's, therefore, were reported primarily to assist future program planning rather than as a site-specific assessment of coho abundance.

1980: A total of 101,073 juvenile coho salmon were captured in nine major upper Pitt River rearing areas by expending 4,556 trap-days effort over a 44-day trapping period (Table 1a). Bears continued to be a problem during the 1980 program, destroying 133 traps and disturbing holding pens on two occasions; however, freshets were not a problem during 1980 due to the installation of floats (boat bumpers) which permitted the holding pens to float during high discharges. This prevented fish loss during freshets on September 20 and 29.

The largest catches occurred in Boise Creek, which contributed 27% to the total catch and accounted for 20% of the total trapping effort. The smallest catches occurred in Forestry and Garibaldi creeks, which contributed 5% and 8% respectively to the total catch and together accounted for 11% of the total trapping effort. Annual catches by trap site are compared graphically in Figure 3. The largest interannual change occurred in Boise Creek where a substantial redistribution of catch from the south to the north branch occurred. This was associated with a reduction in flow in South Boise Creek caused by the formation of a large gravel berm at the branch point.

Coho catch per trap-day averaged 22.2 in 1980 and was similar to the 1979 CPE of 23.3. CPE's ranged from a low of 14.4 in Fish Hatchery Creek to a high of 32.2 in North Boise Creek. In general, CPE's were more consistent among areas during 1980 (Fig. 3), reflecting an improvement in the site-specific allocation of time and effort.

Nonsalmon Species

1979: A total of 2,397 trout fry, 18 Dolly Varden char, 4,378 sculpins, 116 salamander larvae, 4 lampreys and 1 stickleback were captured incidentally to coho juveniles during 1979 (Table 1b). These catches, however, may not be indicative of relative species abundance since nonsalmon species were released immediately upon checking the minnow traps and repeated recaptures were expected.

Trout were most abundant in Blue Creek, which produced 64% of the total catch of trout fry. Although most trout fry were released immediately, a subsample was retained in each area for species identification. Cutthroat trout **(Salmo clarki clarki)** were predominant in most areas, accounting for 68% of the trout identified to species in 1979 (Table 2). Rainbow trout **(S. gairdneri)** constituted the remainder of the trout samples. Sculpins, identified almost entirely as **Cottus aleuticus** (only two were identified as **C. asper)** , were most abundant in Boise Creek and Boise Flats, which together produced 68% of the total sculpin catch. Sculpins were distributed as far upstream as the second canyon, where a series of rapids may impede further upstream movement; no sculpins were observed beyond the second canyon during 1979.

1980: A total of 2,425 trout fry, 7,713 sculpins, 3 Dolly Varden char and 48 salamander larvae were captured incidentally to coho juveniles during 1980 (Table 1b). The

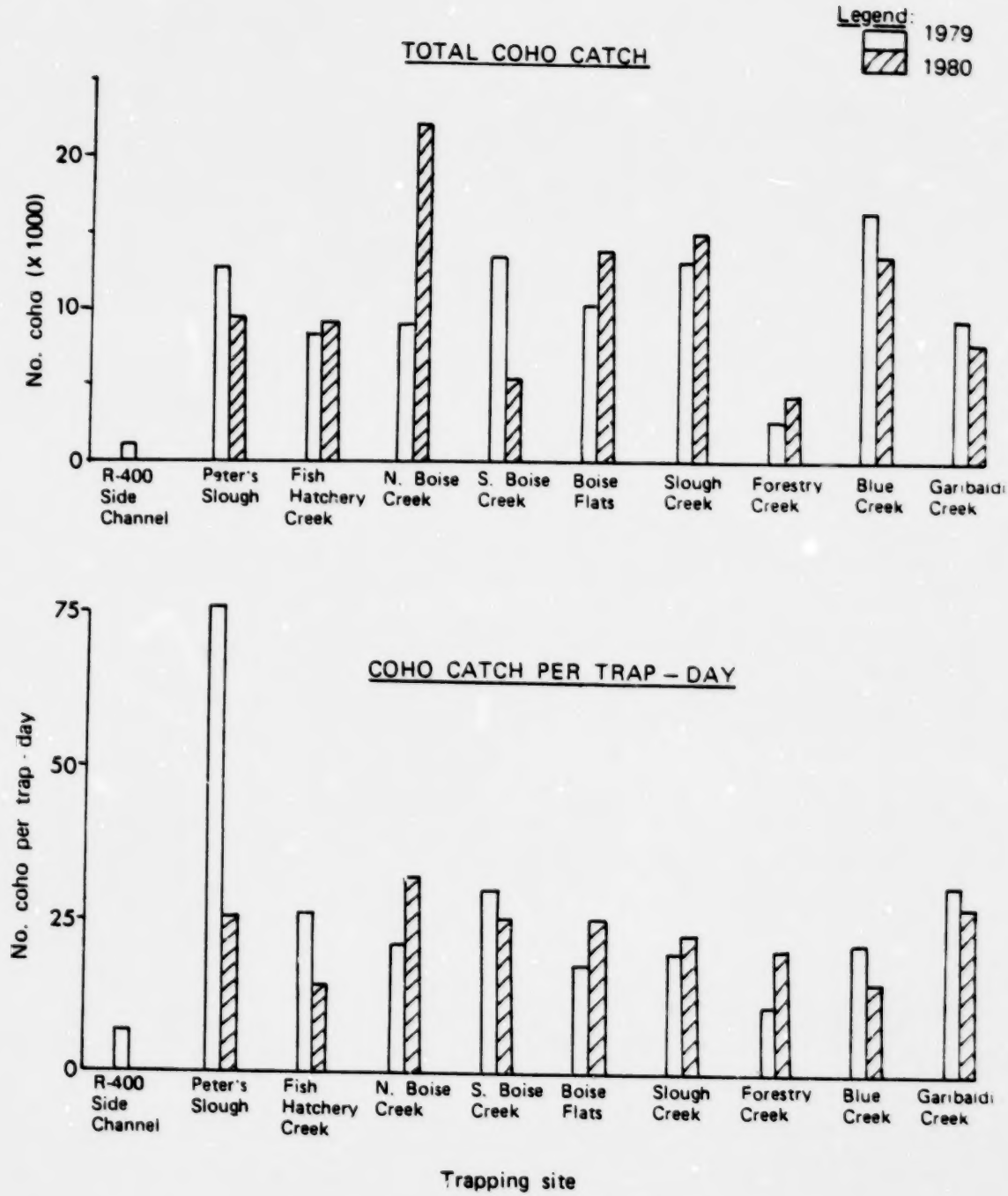

Fig. 3. Total coho catch and catch per trap-day for individual trapping sites in the upper Pitt River system, 1979 and 1980.

Table 1b. Nonsalmon species minnow trapping results by area in the upper Pitt River system, 1979 and 1980[a].

Location	Trout fry[b]	Dolly Varden	Sculpins[c]	Salamander larvae	Other
			1979		
R-400 Side Channel	-	-	-	6	-
Peter's Slough	-	-	347	-	4 lamprey
Fish Hatchery Creek	151	-	281	58	1 stickleback
N. Boise Creek	1	3	1,025	-	-
S. Boise Creek	3	2	1,034	10	-
Boise Flats	4	1	939	2	-
Slough Creek	347	-	652	26	-
Forestry Creek	117	-	100	-	-
Blue Creek	1,541	1	-	13	-
Garibaldi Creek	233	11	-	1	-
TOTAL	2,397	18	4,378	116	-
			1980		
Peter's Slough	6	-	1,018	-	-
Fish Hatchery Creek	188	-	399	29	-
N. Boise Creek	20	-	2,916	2	-
S. Boise Creek	12	-	856	1	-
Boise Flats	20	-	1,172	-	2 shrews
Slough Creek	299	1	936	8	-
Forestry Creek	65	-	416	-	-
Blue Creek	1,601	-	-	8	-
Garibaldi Creek	214	2	-	-	-
TOTAL	2,425	3	7,713	48	-

[a] For capture dates, see Table 1a.

[b] Trout fry were not identified to species during trapping; see Table 2 for subsample identification.

[c] All sculpins were identified to species prior to release. With the exception of two **Cottus asper** captured in lower Fish Hatchery Creek in 1979, all sculpins were identified as **Cottus aleuticus.**

Table 2. Summary of trout subsamples identified to species during tagging operations in the upper Pitt River system, 1979 and 1980.

Year	Location	Sample size	Rainbow trout	Cutthroat trout
1979	Peter's Slough	3	2	1
	N. Boise Creek	29	27	2
	S. Boise Creek	2	1	1
	Slough Creek	63	0	63
	Forestry Creek	75	19	56
	Blue Creek	615	203	412
	TOTAL	787	252	535
	% TOTAL	-	32.0	68.0
1980	Fish Hatchery Creek	35	2	33
	N. Boise Creek	21	19	2
	Boise Flats	6	4	2
	Slough Creek	76	2	74
	Forestry Creek	57	16	41
	Blue Creek	177	55	122
	Garibaldi Creek	76	19	57
	TOTAL	448	117	331
	% TOTAL	-	26.1	73.9

catch distribution by species was similar to that observed in 1979. Trout fry were most abundant in Blue Creek, which produced 66% of the total catch, and cutthroat trout were predominant in most areas, comprising 74% of the trout identified to species (Table 2). The sculpin catch, consisting entirely of **C. aleuticus**, was again restricted to the areas downstream from the second canyon, with Boise Creek and Boise Flats accounting for 64% of the sculpin catch.

Predation by larger sculpins on coho juveniles was noted in several study areas during both 1979 and 1980. Although sculpins normally feed primarily on aquatic insect larvae (Ringstad and Narver 1973), sculpin gut samples contained up to three coho juveniles each, indicating that sculpins can effectively prey upon coho within the confines of a minnow trap. Caution should be exercised, therefore, when conducting minnow trapping programs in areas of high sculpin abundance.

CODED WIRE TAGGING

1979

A total of 63,108 age 0+ and 19,365 age 1+ coho juveniles were adipose clipped and coded wire tagged during 1979 (Table 3, Appendices 4a and 4b). When adjustments were made for delayed (24-hour) tag loss and mortality, the number released with tags was 62,380 age 0+ and 19,045 age 1+ coho. Delayed tag loss for age 0+ coho averaged 0.6%, with a daily tag

Table 3. Summary of coho tagging results by age and year for the upper Pitt River system, 1979 and 1980 (data extracted from Appendix 4).

Year	Age	Number marked	Estimated post-tagging mortality	Adipose only and tag loss	Number released with tags	Tag code
1979	0+	63,108	312	416	62,380	02 16 62
	1+	19,365	57	263	19,045	02 16 60
1980	0+	70,923	171	292	70,460	02 18 03
	1+	15,690	11	266	15,413	02 18 02

lot range of 0.1% to 1.8%; delayed tag loss for age 1+ coho averaged 1.2%, with a range of 0% to 8.8%. Holding time prior to tagging averaged 5 days (range 1-11 days) for age 0+ and 6 days (range 2-11 days) for age 1+ coho juveniles, during which time mortality was negligible. Post-tagging mortality was also low and generally occurred immediately after tagging, presumably a result of overanaesthetization or handling stress. Exceptions were the relatively high short term mortalities observed among age 0+ coho on September 6 and October 2, 1979 and among age 1+ coho on October 2, 1979 which resulted from holding during freshet conditions.

The incidence of disease, damage and structural anomalies among age 0+ and age 1+ coho encountered during tagging was 0.3% and 3.6% respectively (Appendix 5a). Among age 0+ juveniles, the most prevalent condition was tail rot (0.1%), a fungal infection associated with handling stress (Wood 1974), and lordosis (0.08%), a vertical twisting of the spine. The latter condition was most notable in Fish Hatchery Creek where it affected 2.3% of the catch. Among age 1+ juveniles, by far the most prevalent condition was nose damage (3.1%) caused by abrasion against the sides of the holding pens. The incidence of naturally missing adipose fins, defined as a deformed fin which might be mistaken for an incomplete clip, was 0.003% (2 fish) and 0% among age 0+ and age 1+ coho respectively.

1980

A total of 70,923 age 0+ and 15,690 age 1+ coho juveniles were adipose clipped and coded wire tagged during 1980 (Table 3, Appendices 4c and 4d). When adjustments were made for delayed (24-hour) tag loss and mortality, the number released with tags was 70,640 age 0+ and 15,413 age 1+ coho. Delayed tag loss for age 0+ coho averaged 0.3%, with a daily tag lot range of 0% to 1.9%; delayed tag loss for age 1+ coho averaged 1.4%, with a range of 0% to 11.6%. Due to continuous tagging, holding time prior to tagging was less than one day in all cases, and holding mortality was negligable. Post-tagging mortality was also low.

The incidence of disease, damage and structural anomalies among age 0+ and age 1+ coho juveniles encountered during tagging was 0.3% and 0.8% respectively (Appendix 5b). Among age 0+ juveniles, scale loss (0.09%) and lordosis (0.05%) were the most commonly observed defects. Among age 1+ juveniles, the most prevalent defects were nose damage (0.2%) and general

body damage (0.1%). The incidence of natually missing adipose fins was 0.004% (3 fish) and 0.032% (5 fish) among age 0+ and age 1+ coho respectively. The incidence observed in both years was below the average incidence of 0.045% reported by Blankenship (1981) for juvenile coho in U.S. hatcheries, and below 0.08% reported in other programs (Argue and Armstrong 1977, Patterson et al. 1979), and is unlikely to affect either the assessment of tag loss or the marked: unmarked ratio of adult returns.

Delayed Tag Loss

The assessment of CWT loss during field studies is normally limited to short time frames of up to 48 hours. In the upper Pitt River study, however, CWT's were applied to rearing coho juveniles which would remain in fresh water a further eight to twenty months. It was possible, therefore, to assess the incidence of tag loss in juveniles recaptured during the same tagging season and, in 1980, in juveniles recaptured one year after tagging. Estimates of tag loss over short (24 hours), intermediate (up to one month) and long (one year) time frames are summarized in Table 4.

Short term tag loss, estimated from tag lot subsamples retained for 24 hours, was discussed earlier and is detailed in Appendices 4a through 4d. Short term tag loss during 1979 and 1980 averaged 0.6% and 0.3% respectively in age 0+ coho, and 1.2% and 1.4% respectively in age 1+ coho.

The incidence of tag loss over a period of up to 36 days was estimated from recaptures of tagged juveniles which had migrated during the same season from the original release site to a recapture site in a different tributary (Appendix 4e). In 1979, a total of 667 age 0+ coho and 181 age 1+ coho were recaptured in the upper Pitt River system between 6 and 34 days after tagging. The estimated incidence of tag loss in age 0+ fish increased to 2.5% from a short term tag loss rate of 0.6%, and in age 1+ fish to 5.9% from a short term rate of 1.2%. In 1980, 122 age 0+ coho were recaptured between 3 and 36 days after tagging. The estimated incidence of tag loss increased to 4.9% from a short term level of 0.3%. All age 1+ recaptures had fully healed adipose scars, indicating that most if not all had been tagged in 1979. Intermediate tag loss, therefore, could not be calculated in 1980.

Table 4. Incidence of tag loss in the upper Pitt River coho juveniles, 1977 to 1979 broods (sample size is bracketed; data extracted from Appendix 4).

Brood year	Tagging year	Age at tagging	Tag loss (%)		
			Short term	Intermediate	Long term
1977	1979	1+	1.2 (3,785)	5.9 (181)	N/A
1978	1979	0+	0.6 (8,030)	2.5 (667)	9.2 (2535)
1978	1980	1+	1.4 (3,144)	N/A	N/A
1979	1980	0+	0.3 (9,685)	4.9 (122)	N/A

N/A - not available.

The above levels of tag loss were similar to the estimates of 1.5% to 5.1% reported in U.S. hatcheries for coho juveniles averaging 2.2 g to 7.6 g (overall N = 31,253) which were inspected 4 to 10 months after tagging (Blankenship 1981). The above data suggest that a considerable increase in tag loss occurred between 24 hours and one month after tagging; however, since recaptures could not be related to precise tagging dates, the critical period for tag loss remains unclear.

Long term tag loss was estimated from the recapture in 1980 of 2,535 age 1+ juveniles which had been released with CWT's in 1979 (Appendix 4e). The long term tag loss incidence of 9.2% was greater than both the intermediate (2.5%) and short term (0.6%) tag loss levels recorded for that brood year. The incidence of tag loss after one year was equivalent ($p < 0.05$) to the overall tag loss rate of 13.0% reported for the 1981 upper Pitt River coho spawning ground recoveries from the 1978 brood year (DFO unpublished).

The present study suggests a significant increase in tag loss occurred beyond the first 24 hours and possibly beyond a month after tagging and an apparent cessation of tag loss after one year. Comparable assessments of long term tag loss in wild stocks are unavailable; however, long term tag loss has been assessed in hatchery stocks. Blankenship (1981) found that most tag shedding in hatchery stocks occurred two to four weeks after tagging and concluded that tag loss observed one month after tagging may represent the final level of tag loss. Similarly, Bergman et al. (1968) estimated tag loss over a one-year period in juvenile chinook (overall N = 2,924; mean tagging length 48 mm) in a Washington hatchery and found that tag loss occurred only in the first month following tagging.

BIOLOGICAL SAMPLING

Tag Group Sampling

Age Class Separation: The accuracy of sorting by age class, using both fork length and eye size as distinguishing characteristics, was evaluated through scale/age verification from subsamples of 25 coho from each tag lot. In 1979, an estimated 89.9% of the age 0+ juveniles and 96.0% of the age 1+ juveniles were aged correctly and released with the appropriate CWT code (Appendix 6a). In 1980, an estimated 93.1% of the age 0+ juveniles and 98.1% of the age 1+ juveniles were aged correctly and released with the appropriate CWT code (Appendix 6b). The sample data were also weighted by the CWT release group size in each study area to estimate the age composition of each CWT code. In 1979, an estimated 98.7% and 80.8% of the age 0+ (code 02 16 62) and age 1+ (code 02 16 60) CWT release groups respectively were composed of appropriately aged juveniles. In 1980, an estimated 98.9% and 95.7% of the age 0+ (code 02 18 03) and age 1+ (code 02 18 02) CWT release groups respectively were composed of appropriately aged individuals.

To compare the expected age discrimination accuracies of the fixed body size and eye size techniques with the study technique, the sample data were fitted to a fixed fork length cutoff point of 67.5 mm (Fig. 4) and the fixed eye diameter cutoff point of 5.5 mm (Fig. 5), both criteria adopted in 1979. In 1979, the study technique using both features combined resulted in an overall 91.3% correct CWT release, compared to an expected 89.0% and 90.5% using a fork length cutoff and an eye diameter cutoff respectively (Table 5). In 1980, the study technique resulted in a 94.0% correct CWT release, compared to an expected 93.2% and 96.6% using

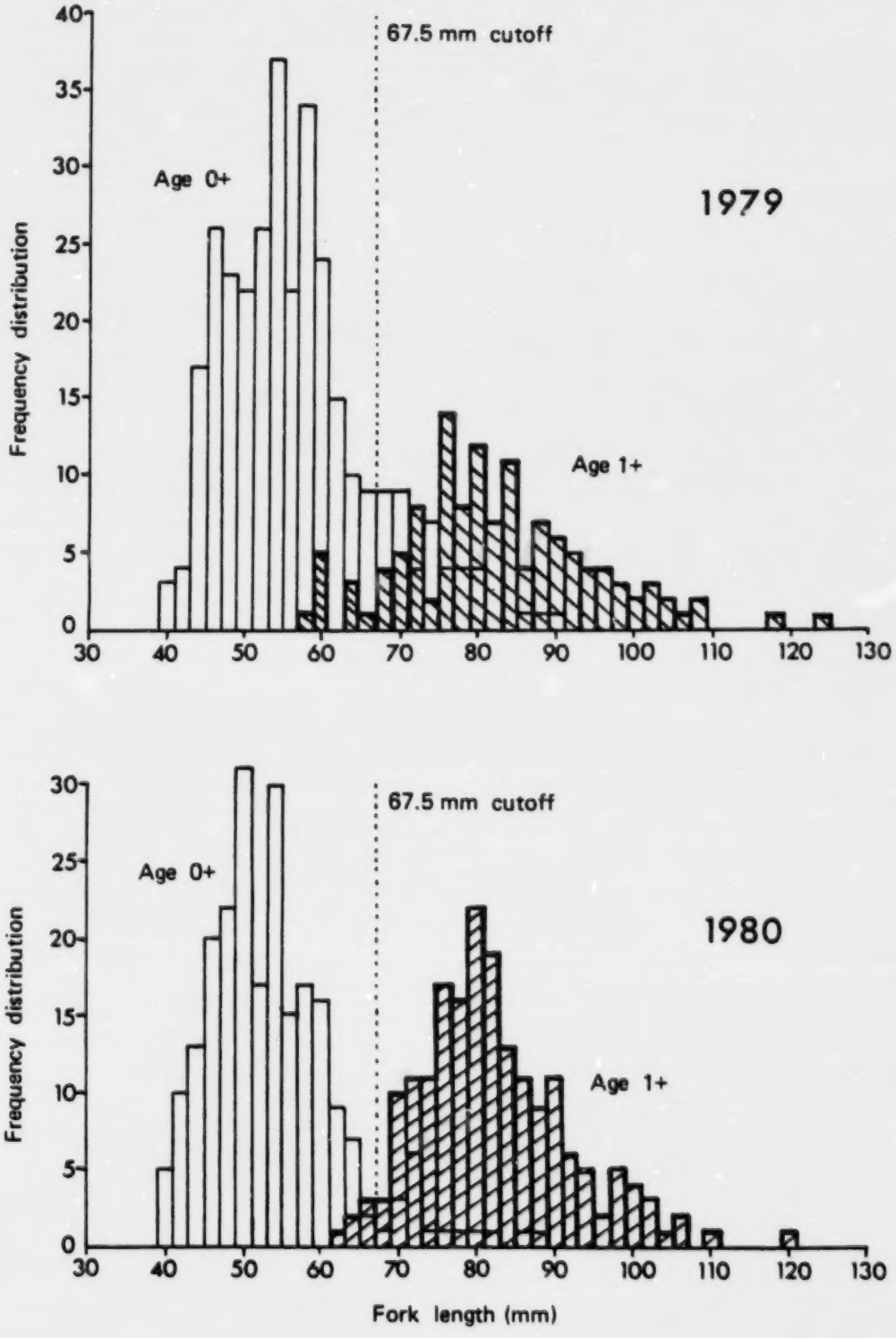

Fig. 4. Fork length frequency distribution for coho juveniles in the upper Pitt River system, 1979 and 1980.

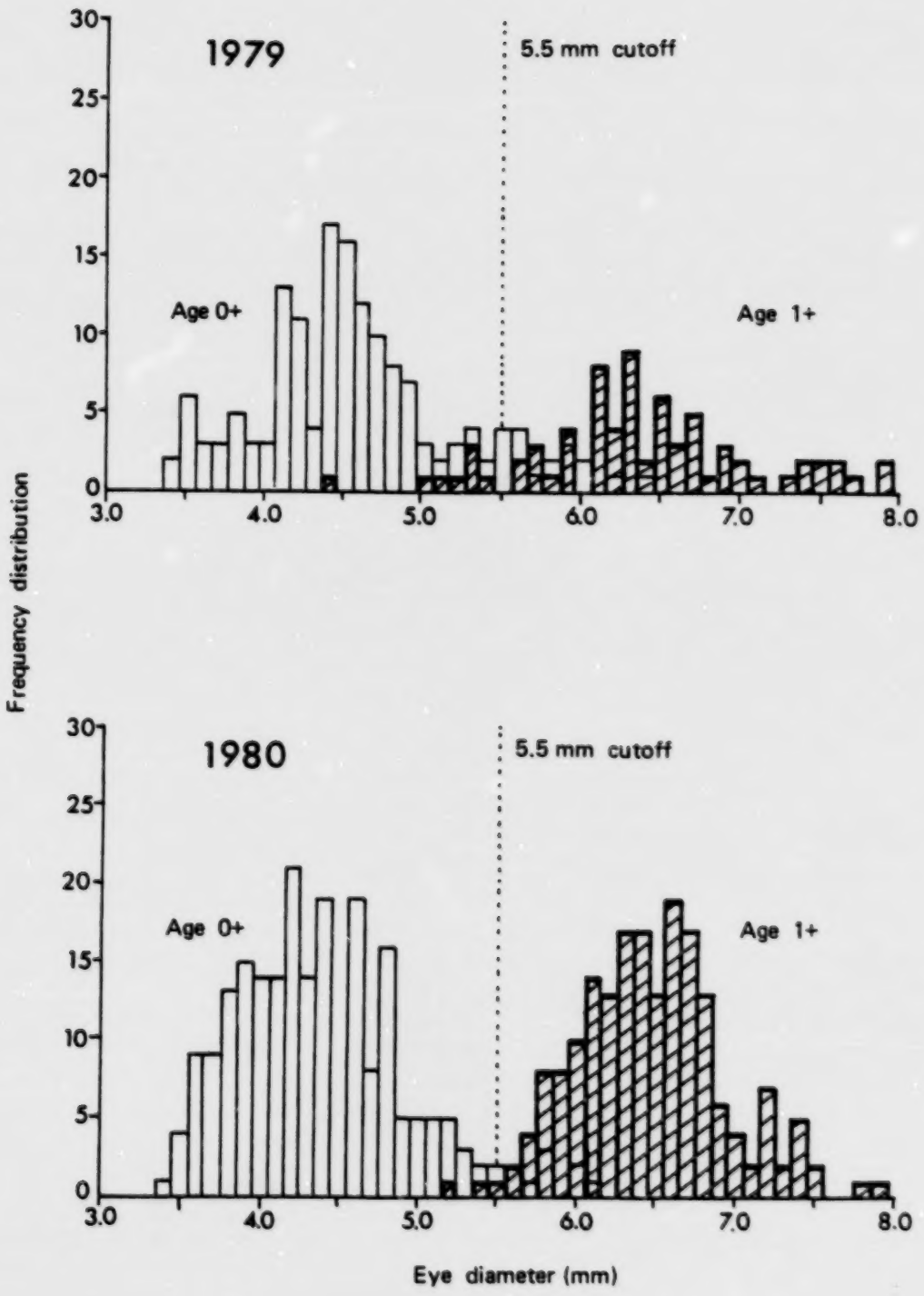

Fig. 5. Eye diameter frequency distribution for coho juveniles in the upper Pitt River system, 1979 and 1980.

Table 5. Comparison of three techniques for the sorting by age class of coho juveniles in the upper Pitt River system, 1979 and 1980 (n = sample size).

Year	Age	Combined technique		Fork length cutoff (67.5 mm)		Eye diameter cutoff (5.5 mm)	
		n	% correct	n	% correct	n	% correct
1979	0+	316	89.9	316	88.3	155	91.0
	1+	126	96.0	126	91.3	71	88.7
	Total[a]	442	91.3	442	89.0	226	90.5
1980	0+	231	93.1	231	92.6	231	96.1
	1+	189	98.1	189	95.8	189	98.9
	Total[a]	420	94.0	420	93.2	420	96.6

[a] Weighted by tag lot sizes.

Table 6. Comparison of mean eye diameter in age 0+ and age 1+ coho of similar fork length captured in the upper Pitt River system during October 10 through November 15, 1979 and August 14 through November 19, 1980 (n = sample size).

Fork length range (mm)	Age 0+ n	Age 0+ Mean eye size (mm) (±95% CL)	Age 0+ Mean Length (mm) (±95% CL)	Age 1+ n	Age 1+ Mean Eye size (mm) (95% CL)	Age 1+ Mean Length (mm) (±95% CL)
			1979			
30-39	1	3.89	37.0	0	-	-
40-49	126	4.03 ± 0.06	45.9 ± 0.4	0	-	-
50-59	147	4.48 ± 0.05	53.9 ± 0.5	5	5.16 ± 0.97	56.8 ± 3.1
60-69	59	5.08 ± 0.10	64.3 ± 0.8	10	5.66 ± 0.37	66.0 ± 2.2
70-79	31	5.29 ± 0.22	73.5 ± 1.1	39	6.11 ± 0.12	75.3 ± 0.9
80-89	10	5.38 ± 0.27	84.1 ± 2.7	32	6.51 ± 0.15	84.2 ± 1.2
90-99	1	5.57	93.0	20	6.73 ± 0.27	93.0 ± 1.3
100-119	0	-	-	9	7.21 ± 0.41	105.6 ± 4.2
TOTAL	375	-	-	115	-	-
			1980			
30-39	3	3.39 ± 0.45	38.3 ± 2.13	0	-	-
40-49	226	3.95 ± 0.08	46.0 ± 0.33	1	3.91	48.0
50-59	326	4.51 ± 0.04	53.8 ± 0.61	4	4.97 ± 0.44	58.0 ± 1.97
60-69	81	4.93 ± 0.06	62.7 ± 0.58	81	5.64 ± 0.08	65.8 ± 0.52
70-79	13	5.51 ± 0.17	72.8 ± 1.54	155	6.04 ± 0.04	74.5 ± 0.45
80-89	5	5.91 ± 0.15	83.2 ± 4.09	133	6.50 ± 0.06	83.4 ± 0.65
90-99	0	-	-	46	6.87 ± 0.12	93.5 ± 0.93
100-119	0	-	-	13	7.35 ± 0.24	04.2 ± 2.93
TOTAL	654	-	-	433	-	-

a fork length cutoff and an eye size cutoff respectively. A number of conclusions can be drawn from these data. First, the "double feature" age class separation technique used in this study permitted rapid and accurate field sorting by age class. This technique was the most reliable of the three in 1979, when substantial size overlap in both these features existed between age classes; however, even when size overlap was minimal, as in 1980 (Figs. 4 and 5), the study technique was more reliable than the fixed fork length cutoff technique (Table 5). Second, since the study technique involved a subjective evaluation of fork length and of the fork length to eye size relationship rather than an absolute cutoff level, it was not as sensitive as a fixed point cutoff method to inseason growth or to site-specific differences in growth and fish size. Finally, when size overlap was small, a fixed point cutoff was an effective sorting technique. In this situation, our results suggest that the eye diameter cutoff was superior to the fixed fork length cutoff technique.

To investigate more fully the relationship between eye size and age in upper Pitt River coho, we examined all samples which showed eye diameter as well as fork length and age. A total of 375 age 0+ and 115 age 1+ coho were sampled in 1979, and 654 age 0+ and 433 age 1+ coho were sampled in 1980 (Table 6). Mean eye diameter in each age class increased with fish size and, when the sample data were stratified in 10 mm fork length increments, within each increment the mean eye diameter of age 1+ juveniles was significantly greater ($p < 0.05$) than that of age 0+ juveniles, despite only minor differences in fork length.

Regressions of eye diameter on fork length were plotted for each age group in each year (Fig. 6) using an analytic procedure which restricted to a maximum of five the number of Y values (eye diameter) at any value of X (fork length) (Non-normal distribution Type C; Ricker 1973). This was done in order to examine a broad range in fork lengths without biasing the analysis with an unmanageable number of observations in any one size group. This procedure provided a predictive regression of Y on X which is a reasonable estimate of the same statistic in the larger distribution; however, the procedure does not provide an unbiased estimate of the functional regression.

Regression analysis confirmed that, within a cohort, eye size was related directly to fork length, and eye size at a given fork length was related directly to age. Similar regression slopes were observed for the 1979 age 0+ and 1+ coho and the 1980 age 1+ coho; in comparison, the calculated slope of the 1980 age 0+ coho was significantly greater ($p < 0.05$) (Fig. 6). This trend would result in a higher degree of overlap in eye diameter later in the year.

The above data suggest that the relationship between age and eye size reported in sockeye (Robinson MS 1976) also exists in coho and that eye size could be a useful criterion for the rapid sorting by age class in the field. Furthermore, age specific differences in eye size were considerably more apparent to a field investigator than might be indicated by the above eye diameter measurements. Eye diameter was measured along a line perpendicular to the longitudinal axis of the body and, since the salmonid eye is vertically compressed, measurements along this axis underestimate the "average" diameter of the eye. As well, a field investigator perceives an eye area rather than a linear measure. Since area is a squared function of any linear measure, the resulting difference in apparent eye size is considerably more dramatic than indicated by diameter measurements (Figs. 7 and 8).

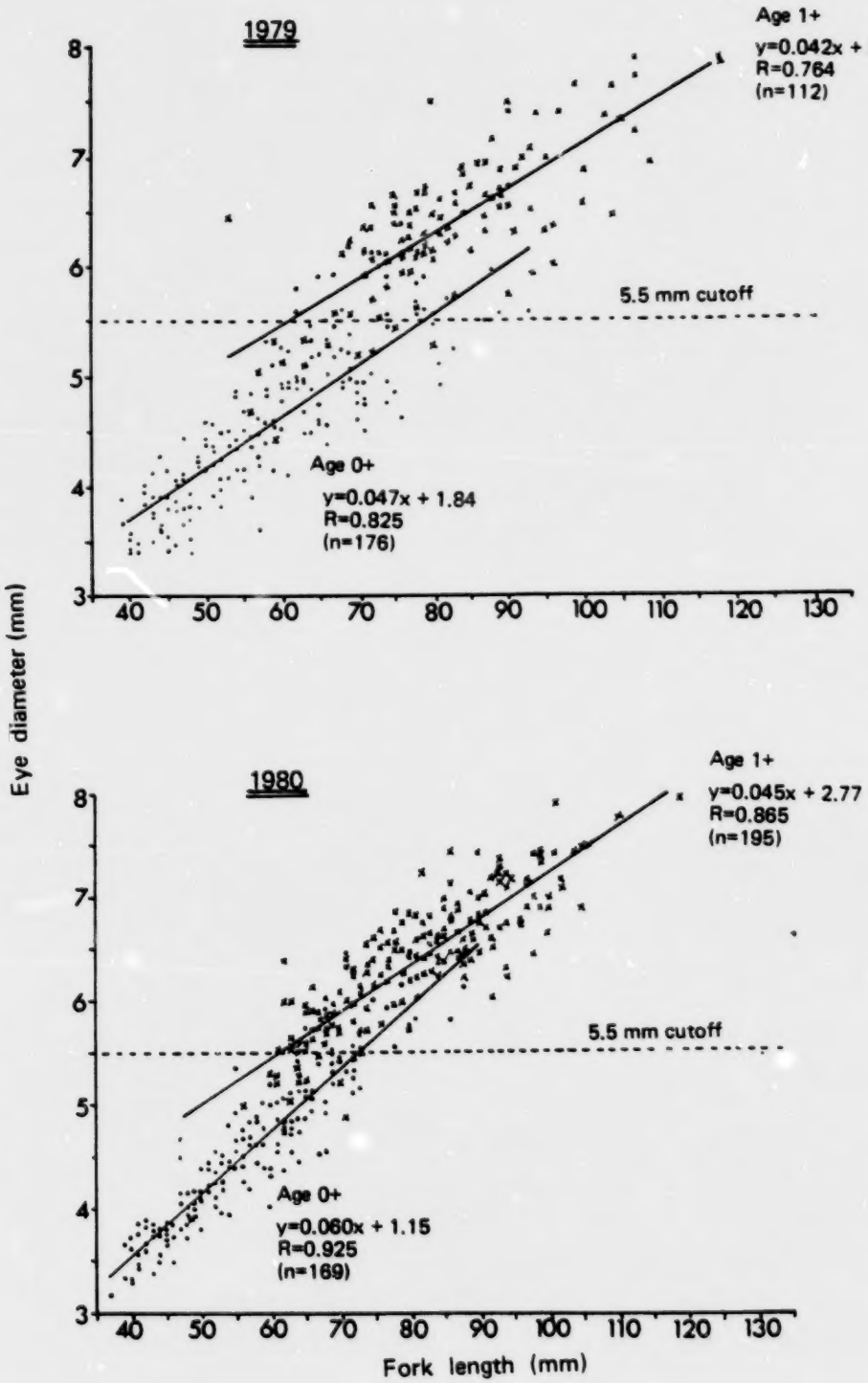

Fig. 6. Relationship between eye diameter and fork length for coho juveniles in the upper Pitt River system, 1979 and 1980 (maximum of 5y values for each x; n=sample size).

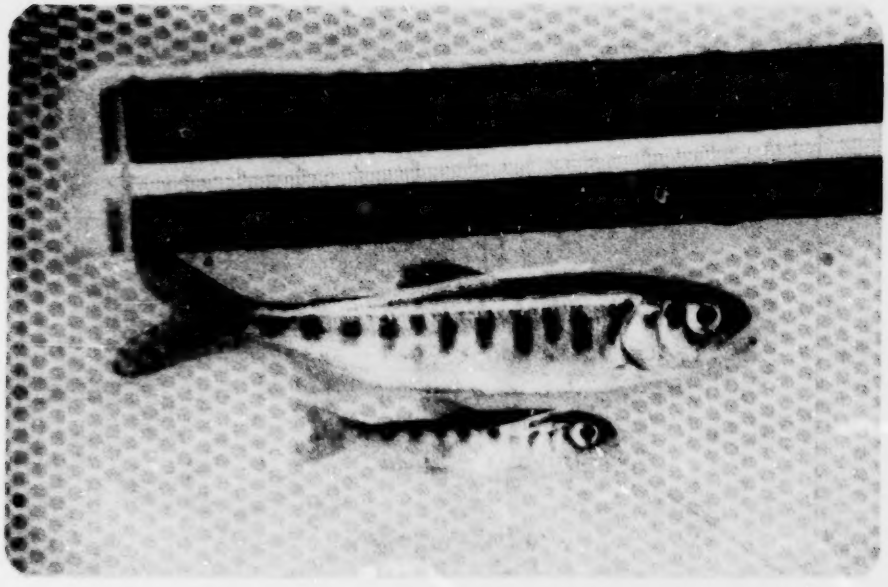

Fig. 7. Age 1+ coho juveniles captured in the upper Pitt River system; note that both fish have a relatively large eye size relative to body size and that the larger fish has a larger eye.

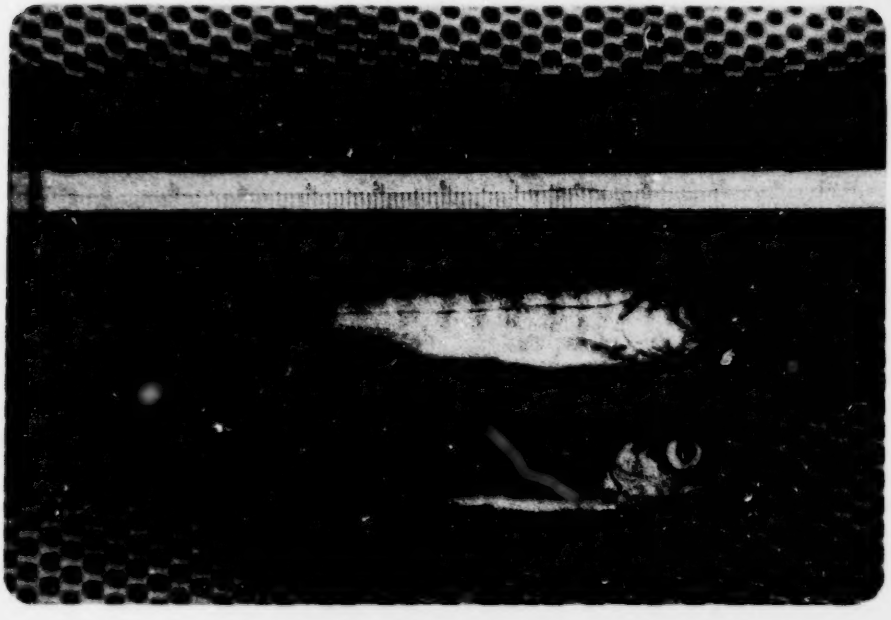

Fig. 8. Age 0+ coho (top) and age 1+ coho (bottom) captured in the upper Pitt River system; note that despite similar body size, the older fish has a larger eye compared to the younger fish.

Table 7. Estimated age composition by area of coho juveniles released with coded wire tags in the upper Pitt River system, 1979 and 1980 (n = sample size).

Year	Location	AGE 0+		AGE 1+	
		n	%	n	%
1979	R-400 Side Channel	693	100.0	0	0.0
	Peter's Slough	11,202	88.8	1,410	11.2
	Fish Hatchery Creek	1,213	73.2	445	26.8
	N. Boise Creek	5,890	67.8	2,800	32.2
	S. Boise Creek	11,131	83.3	2,228	16.7
	Boise Flats[b]	8,544	84.6	1,552	15.4
	Slough Creek	9,847	75.7	3,156	24.3
	Forestry Creek	2,747	96.4	103	3.6
	Blue Creek	11,989	74.4	4,128	25.6
	Garibaldi Creek	1,961	83.6	386	16.4
	TOTAL	65,217	80.1	16,208	19.9
1980	Peter's Slough	9,280	91.7	841	8.3
	Fish Hatchery Creek	7,899	89.2	953	10.8
	N. Boise Creek	11,562	75.3	3,783	24.7
	S. Boise Creek	2,346	61.8	1,451	38.2
	Boise Flats[b]	10,631	86.2	1,700	13.8
	Slough Creek	10,788	77.3	3,176	22.7
	Forestry Creek	3,531	96.7	120	3.3
	Blue Creek	7,206	71.0	2,946	29.0
	Garibaldi Creek	7,076	92.4	584	7.6
	TOTAL	70,319	81.9	15,554	18.1

Age Composition: Estimates of age composition for each study area were corrected for sorting errors (Appendix 6) and are summarized in Table 7. An estimated 80.1% (65,217) of the 1979 release was age 0+ and 19.9% (16,208) was age 1+; during 1980, an estimated 81.9% (70,319) of the release was age 0+ and 18.1% (15,554) was age 1+. These data, however, are specific only to the catch. The age 0+ component of the stream population was not sampled representatively because the smaller individuals could escape through the minnow trap mesh.

Length and Weight: The mean lengths and weights of coho juveniles released with CWT's during 1979 and 1980 are summarized in Table 8, and the detailed length-frequency distributions are reported in Appendix 6. Age 0+ coho averaged 55.7 mm and 1.9 g in 1979, and 53.0 mm and 1.6 g in 1980. Age 1+ coho averaged 82.6 mm and 6.8 g in 1979, and 82.1 mm and 6.6 g in 1980. Little area-specific variability was noted in the size of age 0+ coho in either year, but considerable variability was noted in age 1+ sizes (Table 8); however,

Table 8. Mean sizes of coho juveniles released with coded wire tags in the upper Pitt River system, 1979 and 1980 (n = sample size).

Location	Sampling date	Age 0+ n	Age 0+ Mean Length (mm) (±95% CL)	Age 0+ n	Age 0+ Mean weight (g)	Age 1+ n	Age 1+ Mean Length (mm) (±95% CL)	Age 1+ n	Age 1+ Mean Weight (g)
1979									
R-400 Side Channel	Sep. 06	25	58.9 ± 3.9	-	-	-	-	-	-
Peter's Slough	Nov. 01	25	58.4 ± 4.6	97	1.95	16	91.9 ± 7.9	39	7.06
Fish Hatchery Creek	Oct. 30	15	54.9 ± 3.6	71	3.02	-	-	-	-
N. Boise Creek	Oct. 02	15	54.1 ± 3.0	89	2.01	12	78.7 ± 8.8	25	6.84
S. Boise Creek	Oct. 04	18	55.4 ± 4.3	79	1.81	13	92.1 ± 8.6	25	9.58
Boise Flats	Sep. 24	29	56.4 ± 3.1	98	1.58	13	78.7 ± 4.8	25	6.27
Slough Creek	Sep. 19	27	55.7 ± 3.5	91	1.64	21	83.5 ± 3.8	35	6.13
Slough Creek	Sep. 26	26	53.9 ± 4.3	63	1.71	13	80.1 ± 5.4	25	5.89
Slough Creek	Oct. 30	25	51.3 ± 3.3	89	1.82	7	83.9 ±10.0	25	10.50
Forestry Creek	Sep. 12	48	58.2 ± 2.6	106	2.07	-	-	37	5.98
Blue Creek	Oct. 17	31	53.3 ± 4.1	66	1.26	14	77.9 ± 4.3	56	4.91
Garibaldi Creek	Oct. 29	32	57.3 ± 3.1	111	1.72	15	75.1 ± 4.5	46	4.76
Mean[a]			55.7 ± 1.6		1.87 ± 0.29		82.6 ± 4.7		6.79 + 1.33
1980									
Peter's Slough	Sep. 14	29	57.9 ± 4.5	25	1.89	21	88.2 ± 3.6	25	8.05
Fish Hatchery Creek	Sep. 08	30	55.1 ± 4.1	25	1.60	19	87.6 ± 7.2	25	7.96
N. Boise Creek	Oct. 09	23	54.3 ± 2.3	26	1.80	24	82.9 ± 3.3	25	6.82
S. Boise Creek	Oct. 12	24	51.2 ± 2.8	25	1.47	25	77.7 ± 3.0	25	5.42
Boise Flats	Oct. 02	26	54.1 ± 2.9	25	1.67	21	83.8 ± 4.4	25	6.97
Slough Creek	Sep. 28	24	50.0 ± 3.1	25	1.64	25	74.9 ± 3.2	25	5.16
Forestry Creek	Sep. 05	21	50.3 ± 3.0	24	1.48	23	80.6 ± 2.8	32	5.97
Blue Creek	Oct. 17	25	50.0 ± 4.0	25	1.40	18	79.2 ± 2.7	25	6.05
Garibaldi Creek	Sep. 18	29	54.1 ± 3.7	25	1.49	13	83.7 ± 4.9	25	7.09
Mean[a]			53.0 ± 2.1		1.60 ± 0.12		82.1 ± 3.4		6.61 + 0.78

[a] Mean of means.

sizes were not compared among areas due to unknown growth trends over the protracted sample period.

Tributary Monitoring

North Boise Creek: Minnow traps were set on a regular basis in North Boise Creek to assess seasonal trends in the abundance and size of coho juveniles, and the incidence of adipose marks. Due to problems with gear selectivity, effort variability and site selection encountered in 1979, only the 1980 results are considered to be representative of trends in catch per trap-day (CPE) and fish size in both age groups. The 1979 CPE and fish size data for age 0+ coho were biased by minnow trap size selectivity. Bloom (1976) reported minnow traps were representative samplers of coho juveniles only in 51 mm to 100 mm size range. Coho smaller than 51 mm were not captured in proportion to their occurrence in the population due to the large mesh size of minnow traps. In this study, the use in 1980 of fine-mesh minnow traps presumably eliminated size selective biases.

Table 9. Mean length and weight of coho juveniles captured in North Boise Creek, 1979 and 1980 (n = sample size).

Sampling date	Age 0+				Age 1+			
	n	Mean Length (mm) (±95% CL)	n	Mean Weight (g)	n	Mean Length (mm) (±95% CL)	n	Mean Weight (g)
				1979				
July 17	-	-	-	-	87	69.5 ± 1.8	-	-
Aug. 02	28	58.0 ± 3.0	-	-	72	73.3 ± 2.2	-	-
Aug. 16	15	58.3 ± 3.9	-	-	82	74.0 ± 1.9	-	-
Sep. 07	-	-	-	-	14	74.6 ± 3.3	-	-
Sep. 13	33	53.5 ± 2.1	-	-	12	74.8 ± 2.6	-	-
Oct. 20	23	54.7 ± 3.3	87	1.76	6	82.2 ± 19.6	17	6.29
Nov. 14	35	49.3 ± 1.6	52	1.42	-	-	-	-
Mean[a]	-	54.8 ± 4.6	-	1.59	-	74.7 ± 4.3	-	6.29
				1980				
Aug. 06	-	-	-	-	34	77.0 ± 3.0	-	-
Aug. 14	13	48.1 ± 3.1	21	1.55	37	75.0 ± 2.6	39	5.94
Aug. 20	21	50.8 ± 4.1	29	1.48	25	72.5 ± 5.2	30	5.46
Sep. 03	39	49.6 ± 1.9	60	1.57	8	70.5 ± 5.3	13	5.37
Sep. 11	37	50.5 ± 4.1	78	1.47	11	75.4 ± 6.2	17	5.90
Sep. 23	35	60.0 ± 2.8	47	2.36	14	79.4 ± 5.3	22	6.43
Oct. 01	21	57.1 ± 2.5	37	2.38	11	81.3 ± 4.4	18	7.01
Oct. 15	36	55.6 ± 2.6	40	2.18	8	79.1 ± 6.9	10	6.48
Oct. 22	35	59.7 ± 2.3	36	2.31	10	78.7 ± 4.6		-
Nov. 19	9	64.7 ± 6.2	18	3.52	38	83.0 ± 3.4	32	8.06
Mean[a]	-	55.1 ± 4.4	-	1.87	-	78.9 ± 3.6	-	5.83

[a] Mean of means.

Trends in overall mean coho CPE during 1980 were erratic (Appendix 7b); however, age 1+ CPE's as well as the proportion of age 1+ coho in the catch appeared to decline throughout much of the trapping period, suggesting a possible late season emigration or behavior-related differences between age classes.

The 1979 incidence of adipose marked coho averaged 37.9% and 33.3% in age 0+ and age 1+ juveniles respectively (Appendix 12a). Prior to the 1980 releases of marked fish, the incidence of adipose marked age 1+ juveniles averaged 10.1% (range 0% to 18.2%), a substantial decrease from the 1979 level for the same brood year. These data suggest that, as reported by Bloom (1976), standard minnow traps used during program trapping were selective toward larger age 0+ juveniles which were more likely to emigrate after their first year, and did not representatively capture individuals less than 51 mm in length. The incidence of marked fish after the 1980 release of marked coho averaged 46.9% and 60.7% for age 0+ and age 1+ juveniles respectively. This was considerably higher than the 1979 incidence level, indicating that the larger catches during 1980 were in part a result of more effective fishing effort.

The mean size of age 0+ coho was similar in 1979 and 1980 (despite trap selectivity in 1979), averaging 54.8 mm in 1979 and 55.1 mm and 1.9 g in 1980 (Table 9; weights were not recorded consistently over the 1979 monitoring period). Age 0+ juveniles showed an apparent size increase in 1980 and an apparent size decrease in 1979 (Fig. 9, Table 9). However, the latter trend likely reflects recruitment to the minimum trapping size of the unscreened minnow traps; in 1980, the screened traps prevented the escape of smaller individuals. Mean annual size of age 1+ coho was also similar over the two years of the program and was significantly greater ($p < 0.05$) than that of age 0+ coho. Age 1+ juveniles averaged 74.7 mm in 1979 and 78.9 mm and 5.8 g in 1980 (Table 9). During both years, age 1+ coho showed an apparent size increase throughout the trapping period (Fig. 9, Table 9).

Slough Creek: As for North Boise Creek, the 1979 age 0+ results for Slough Creek were not considered representative of trends in CPE and fish size. Coho CPE in Slough Creek tended to peak in mid-August followed by a general decline for the remainder of the trapping period (Appendix 7d). Both the age 0+ and age 1+ coho followed the same trend in CPE.

The incidence of adipose marked juveniles in Slough Creek was generally higher than in North Boise Creek, averaging 61.5% and 93.8% in age 0+ and age 1+ juveniles respectively in 1979, and 27.9% and 75.0% in age 0+ and age 1+ juveniles respectively in 1980 (Appendix 7d). As noted for North Boise Creek, the 1980 incidence of age 1+ marks in Slough Creek (26.2%; range 11.8% to 35.3%) declined sharply from the 1979 age 0+ level (61.5%), suggesting that size selective program trapping also occurred in Slough Creek.

The mean size of age 0+ coho was similar in 1979 and 1980 (despite trapping selectivity in 1979), averaging 55.0 mm in 1979 and 52.9 mm and 1.8 g in 1980 (Table 10; weights were not recorded consistently in 1979). Age 0+ coho showed no significant size increase over the sample period in either year (Fig. 9, Table 10). Mean annual size of age 1+ coho was 78.9 mm in 1979, significantly larger ($p < 0.05$) than the mean annual size of 73.6 mm reported in 1980. Age 1+ coho showed an apparent seasonal size increase in 1979, but not in 1980 (Fig. 9, Table 10).

Comparison of North Boise and Slough creek juveniles showed no significant size difference between

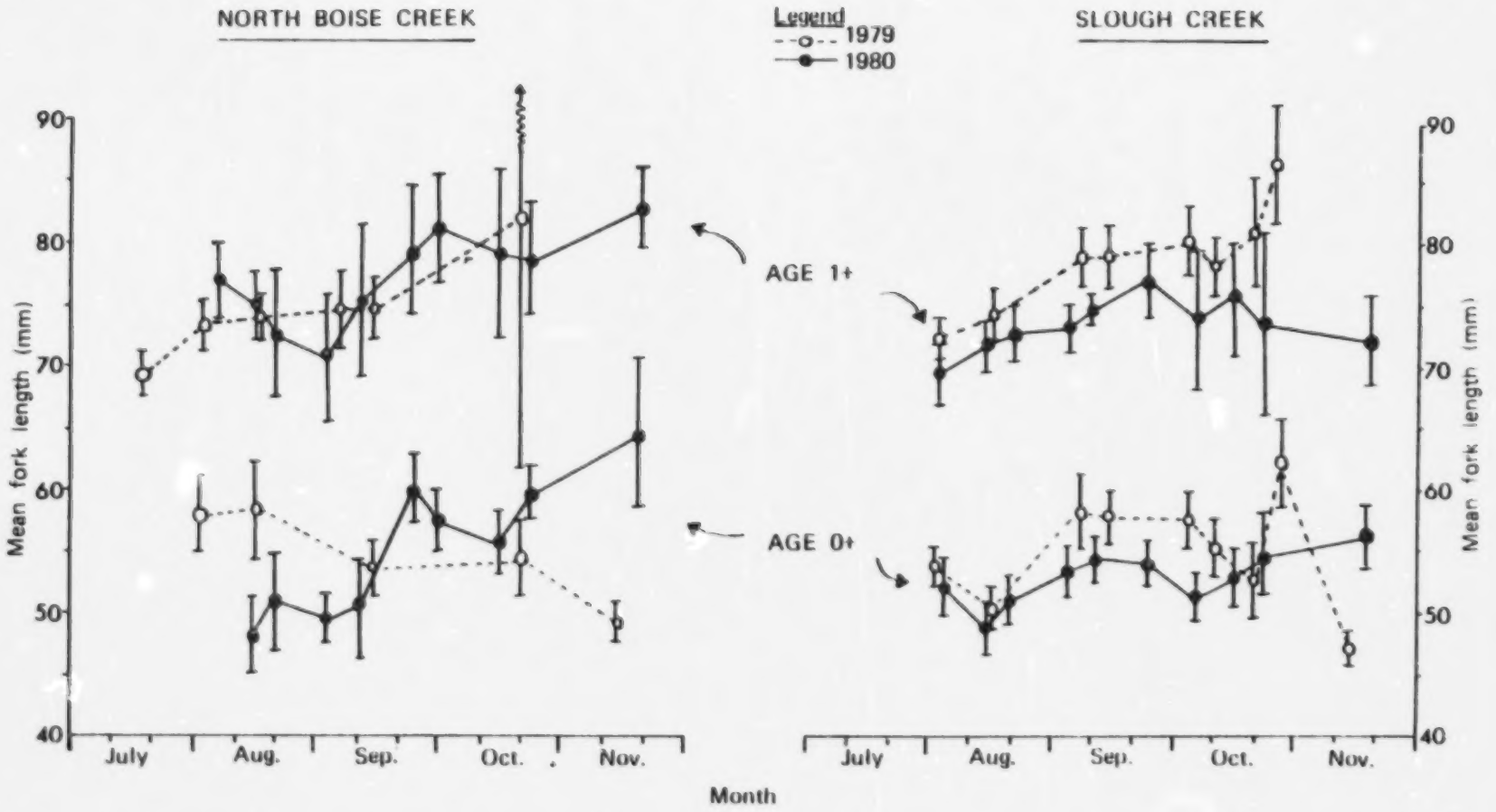

Fig. 9. Mean length of age 0+ and 1+ coho in North Boise and Slough creeks, July to November 1979 and 1980 (vertical bars are 95% CL).

Table 10. Mean length and weight of coho juveniles captured in Slough Creek, 1979 and 1980 (n = sample size).

Sampling date	Age 0+				Age 1+			
	n	Mean Length (mm) (±95% CL)	n	Mean Weight (g)	n	Mean Length (mm) (±95% CL)	n	Mean Weight (g)
1979								
Aug. 02	29	53.6 ± 1.6	-	-	41	72.4 ± 1.6	-	-
Aug. 16	26	50.4 ± 1.8	-	-	23	74.4 ± 2.1	-	-
Sep. 07	18	58.2 ± 2.9	-	-	26	79.0 ± 2.4	-	-
Sep. 13	18	57.8 ± 2.2	-	-	22	79.1 ± 2.5	-	-
Oct. 04	32	57.5 ± 2.4	-	-	13	80.4 ± 2.8	-	-
Oct. 11	42	55.1 ± 2.2	95	1.85	5	78.2 ± 2.4	32	4.63
Oct. 20	31	52.6 ± 3.0	77	1.51	8	81.0 ± 4.6	22	5.48
Oct. 26	28	62.4 ± 3.6	25	2.74	17	86.7 ± 4.9	26	7.39
Nov. 14	36	47.1 ± 1.5	44	1.37	-	-	-	-
Mean[a]	-	55.0 ± 3.6	-	1.87	-	78.9 ± 3.6	-	5.83
1980								
Aug. 06	11	52.1 ± 2.4	-	-	20	69.6 ± 2.7	-	-
Aug. 14	32	48.7 ± 2.2	134	1.42	17	71.9 ± 2.4	24	4.25
Aug. 20	31	51.1 ± 1.9	59	1.59	17	72.9 ± 2.2	55	4.80
Sep. 04	18	53.3 ± 2.2	24	1.93	28	73.3 ± 1,9	44	5.13
Sep. 11	21	54.3 ± 1.9	25	1.81	27	74.7 ± 1.6	31	5.45
Sep. 23	32	54.0 ± 1.9	45	1.83	17	77.2 ± 2.9	26	5.53
Oct. 06	38	51.4 ± 2.0	46	1.60	5	74.0 ± 5.7	7	5.17
Oct. 15	28	52.8 ± 2.3	28	1.93	9	76.2 ± 5.2	15	5.67
Oct. 22	35	54.5 ± 2.8	36	1.95	12	73.8 ± 7.4	14	5.06
Nov. 19	21	56.3 ± 2.7	32	2.43	26	72.4 ± 3.7	19	5.49
Mean[b]	-	52.9 ± 1.5	-	1.83	-	73.6 ± 1.5	-	5.17

[a] Mean of means.

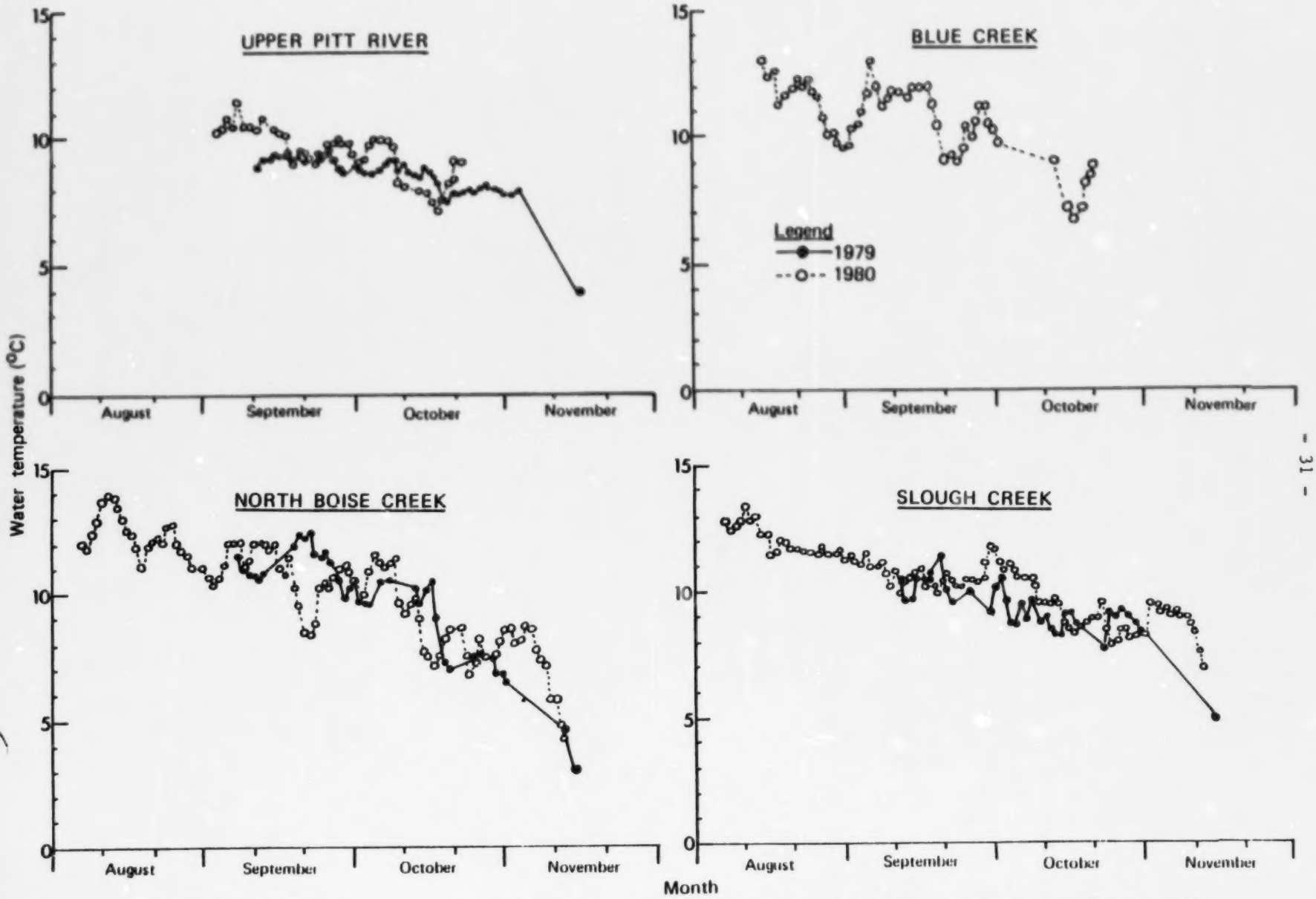

Fig. 10. Mean daily water temperatures in the upper Pitt River and Blue, Slough and North Boise creeks, 1979 and 1980.

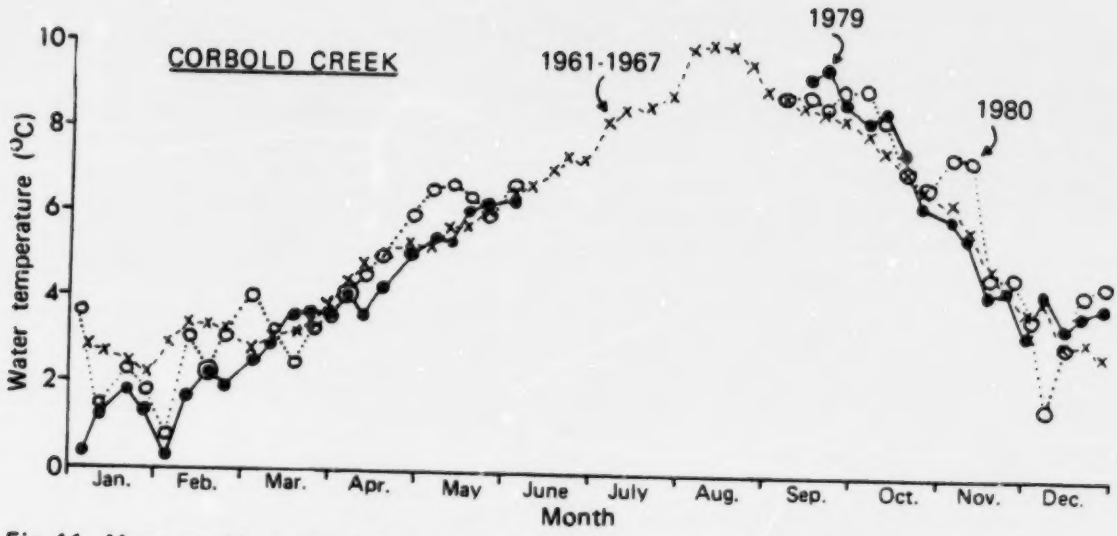

Fig. 11. Mean weekly water temperatures in Corbold Creek, 1961 to 1967, 1979 and 1980 (from IPSFC records).

age 0+ juveniles in either year and no significant size difference between age 1+ juveniles in 1979. However, in 1980, age 1+ coho in Slough Creek were significantly smaller ($p < 0.05$) than those in North Boise Creek. Annual temperature differences may explain these growth trends, but temperature records were incomplete.

Despite considerable habitat differences between North Boise and Slough creeks, few apparent differences were noted when the coho populations in each stream were compared. Both streams showed similar seasonal trends in fish length and weight with little size overlap between the age groups. Mean annual age composition and seasonal age trends were also similar. The only major difference noted was in mark incidence, which was higher in Slough Creek, probably reflecting conditions more favorable to efficient trapping.

PHYSICAL SAMPLING

Water Temperatures

Mean daily water temperatures in the upper Pitt River mainstem, North Boise Creek, Slough Creek and Blue Creek are shown for 1979 and 1980 in Figure 10 and Appendices 9a through 9d. Mean weekly water temperatures in Corbold Creek for the periods 1961 to 1967, 1979 and 1980 were extracted from the IPSFC data files and are shown in Figure 11 and Appendix 9e. For comparative purposes, continuous temperature records at the above sites were also expressed as weekly means (Fig. 12, Appendix 10). At all sites, water temperatures declined from approximately 9-12°C in September to 6-9°C in November. The mainstem generally had more moderate temperatures compared to the other sampled sites, while the glacier-fed Corbold Creek had the lowest temperatures. In general, temperatures were well within the coho tolerance range and were not a factor in fry mortality during the study.

Water Levels

Mean daily staff gauge levels recorded in the upper Pitt River at the bridge site, approximately 4 km upstream, and in lower North Boise Creek are shown in Figure 13 and Ap-

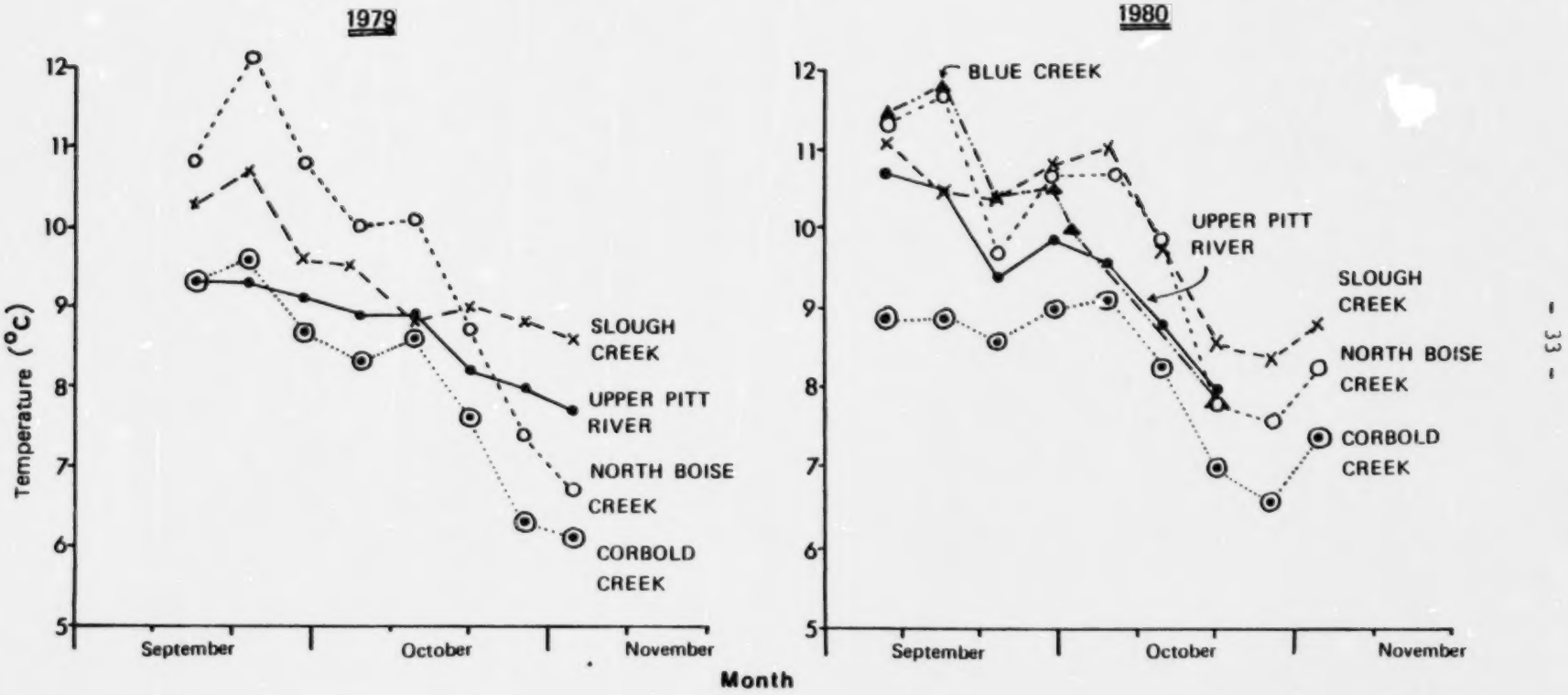

Fig. 12. Mean weekly water temperatures in the upper Pitt River and Blue, Slough, North Boise and Corbold creeks, 1979 and 1980.

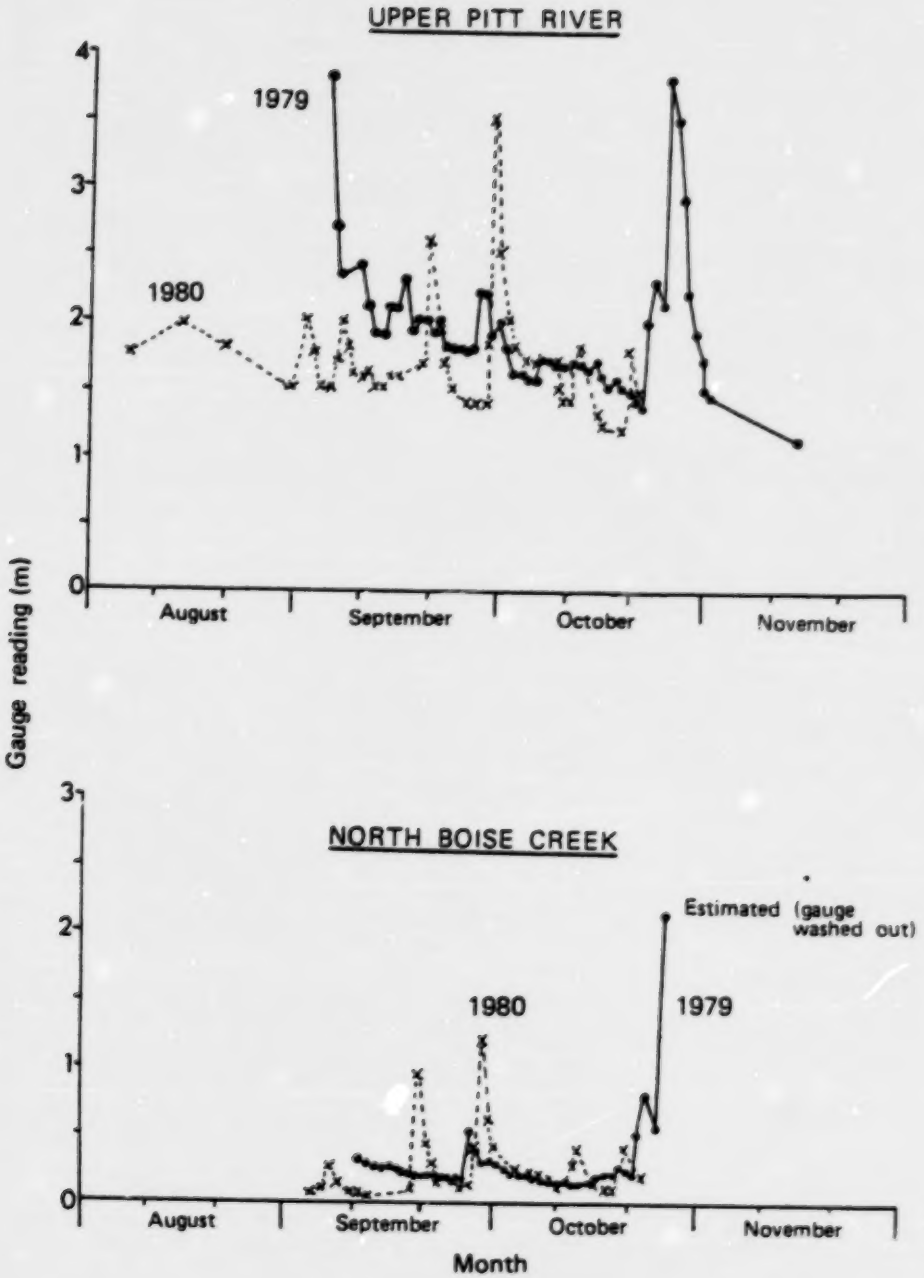

Fig. 13. Mean daily staff gauge readings at the upper Pitt River bridge and lower North Boise Creek, 1979 and 1980.

pendix 11. Sudden freshets associated with heavy precipitation were observed at both locations during September and October 1979 and 1980. On October 25, 1979, a combination of rainfall and snow melt resulted in a 2.3 m rise in mainstem level over a 10-hour period. Such sudden freshets typify the flow regime during the late fall and likely result in substantial intrasystem fry redistribution, as was noted in 1979.

SUMMARY

1. A minnow trapping and coded wire tagging program was conducted in the upper Pitt River system during the autumns of 1979 and 1980 in order to investigate the exploitation rate, catch distribution and survival rate of the upper Pitt River coho stock. Catches totalled 96,845 coho juveniles in 1979 and 101,073 coho juveniles in 1980.

2. In 1979, a total of 63,108 age 0+ coho and 19,365 age 1+ coho were adipose clipped and coded wire tagged; when adjustments were made for delayed (24-hour) tag loss and mortality, an estimated 62,380 age 0+ coho (code 02 16 62) and 19,045 age 1+ (code 02 16 60) were released with adipose clips and coded wire tags.

   In 1980, a total of 70,923 age 0+ coho and 15,690 age 1+ coho were adipose clipped and coded wire tagged; when adjustments were made for delayed (24-hour) tag loss and mortality, an estimated 70,640 age 0+ coho (code 02 18 03) and 15,413 age 1+ coho (code 02 18 02) were released with adipose clips and coded wire tags.

3. The incidence of disease, damage and structural anomlies encountered during tagging was 0.3% and 3.6% in 1979 and 0.3% and 0.8% in 1980 among age 0+ and age 1+ coho respectively.

4. The incidence of tag loss was assessed over short (24-hour), intermediate (up to one month) and long (one year) time frames. Tag loss occurred beyond the first 24-hours and possibly beyond one month after tagging, and was complete after one year. During 1979 and 1980, the incidence of short term tag loss averaged 0.3% to 0.6% in age 0+ juveniles and 1.2% to 1.4% in age 1+ juveniles; intermediate tag loss was 2.5% to 4.9% in age 0+ juveniles and 5.9% in age 1+ juveniles; long term tag loss was 9.2% in juveniles which remained in the stream for one year.

5. Coho juveniles were sorted by age class for tagging using a subjective technique which considered both fork length, and the relationship between fork length and eye size. In 1979, an estimated 89.9% and 96.0% of the age 0+ and 1+ juveniles respectively were aged correctly and released with the correct CWT code; in 1980, an estimated 93.1% and 98.1% of the age 0+ and age 1+ juveniles respectively were aged correctly and released with the correct code. It was concluded that this 'double feature' technique was more effective than a fixed cut-off technique using either fork length or eye size when significant overlap in either morphological feature existed between age classes.

6. An analysis of the relationship between eye size and age indicated that eye size was related directly to fork length and that, at a given fork length, eye size was related directly to age.

7. Age 0+ juveniles released with CWT's averaged 56 mm and 1.9 g in 1979, and 53 mm and 1.6 g in 1980. Age 1+ juveniles released with CWT's averaged 83 mm and 6.8

g in 1979, and 82 mm and 6.6 g in 1980.

8. The 1980 tributary monitoring results for North Boise and Slough creeks showed few apparent differences in the coho populations between creeks despite considerable differences in stream habitats. Coho in both creeks showed similar seasonal trends in fish length and weight with little size overlap between the two age groups. Mean annual age composition and seasonal age trends were also similar.

9. At all the sites (upper Pitt River mainstem, North Boise Creek, Slough Creek and Blue Creek), water temperatures declined between September (9-12°C) and November (6-9°C). Sudden freshets associated with heavy precipitation and snow melt occurred during September and October 1979 and 1980.

ACKNOWLEDGEMENTS

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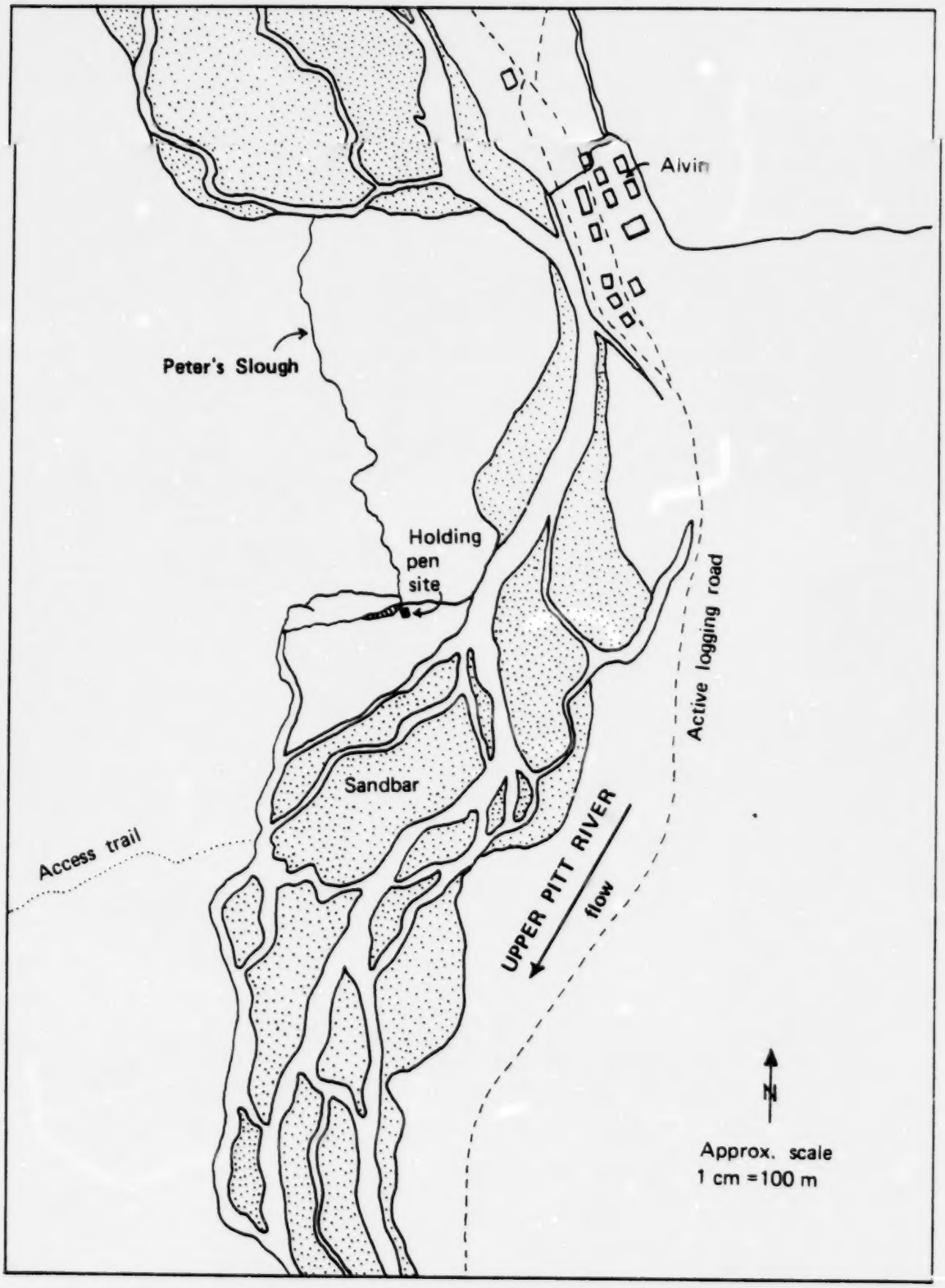
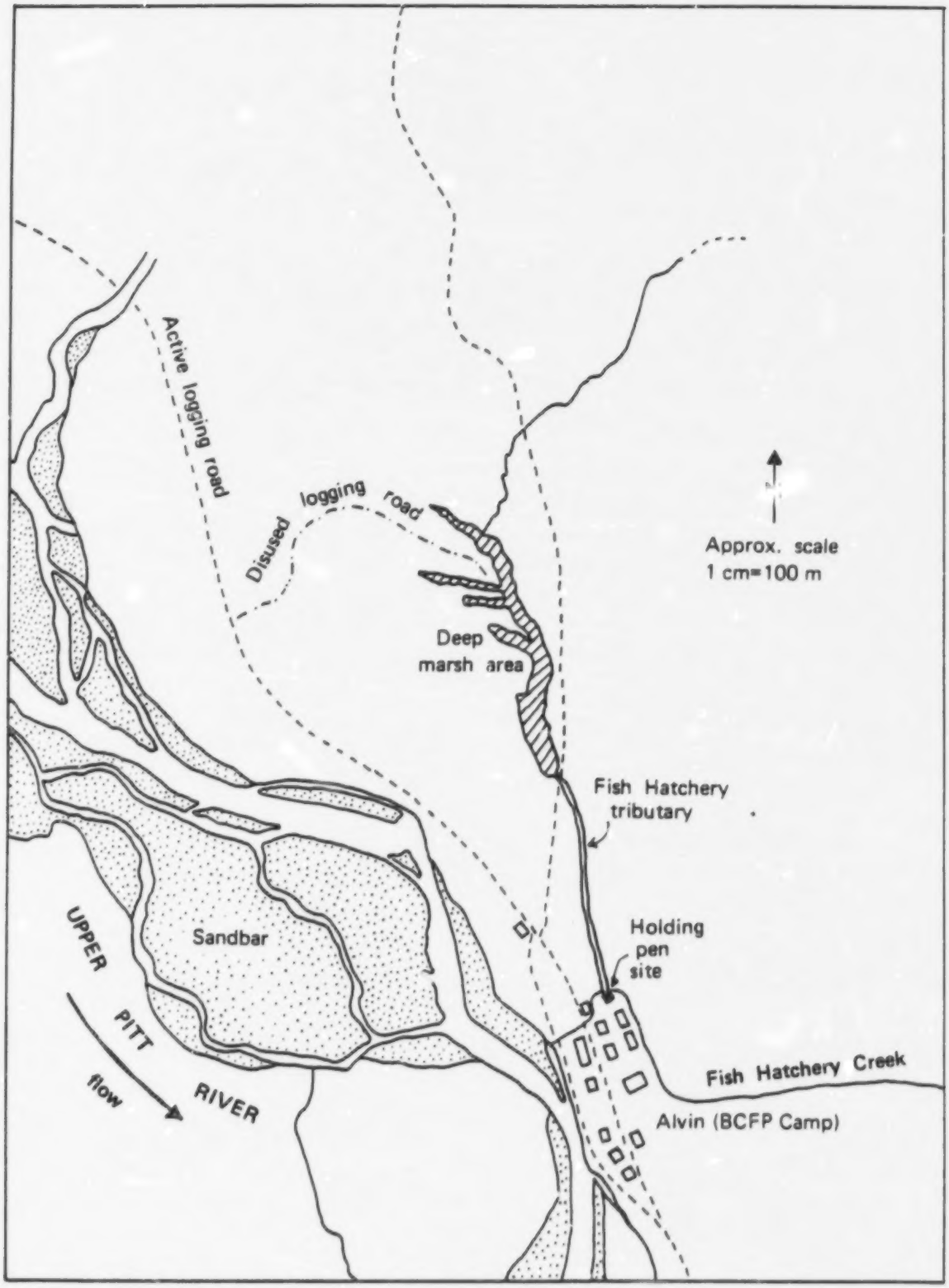
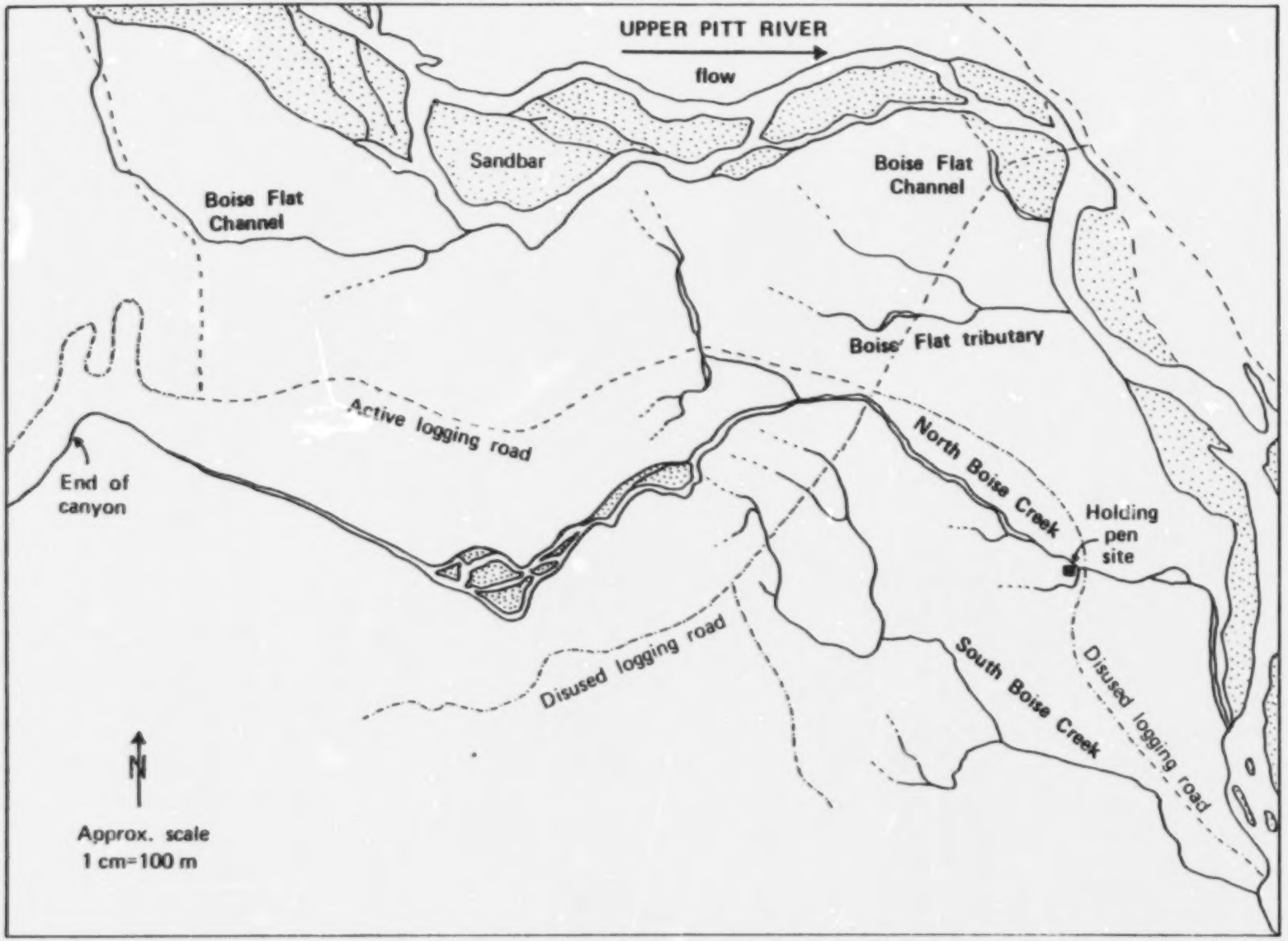
APPENDICES



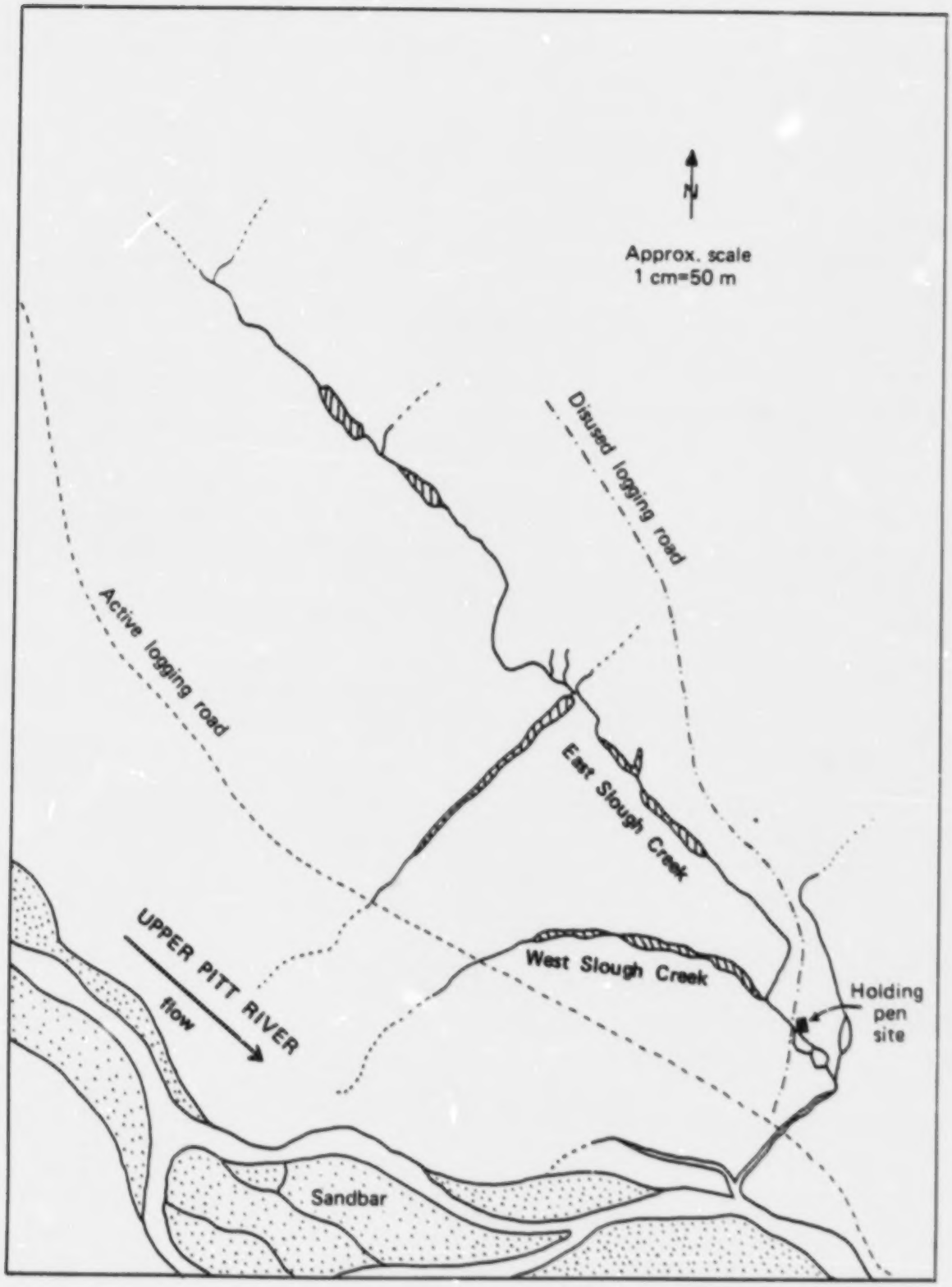
Appendix Fig. 1. Peter's Slough and the holding pen site in the upper Pitt River system, 1979 and 1980 (diagrammatic).



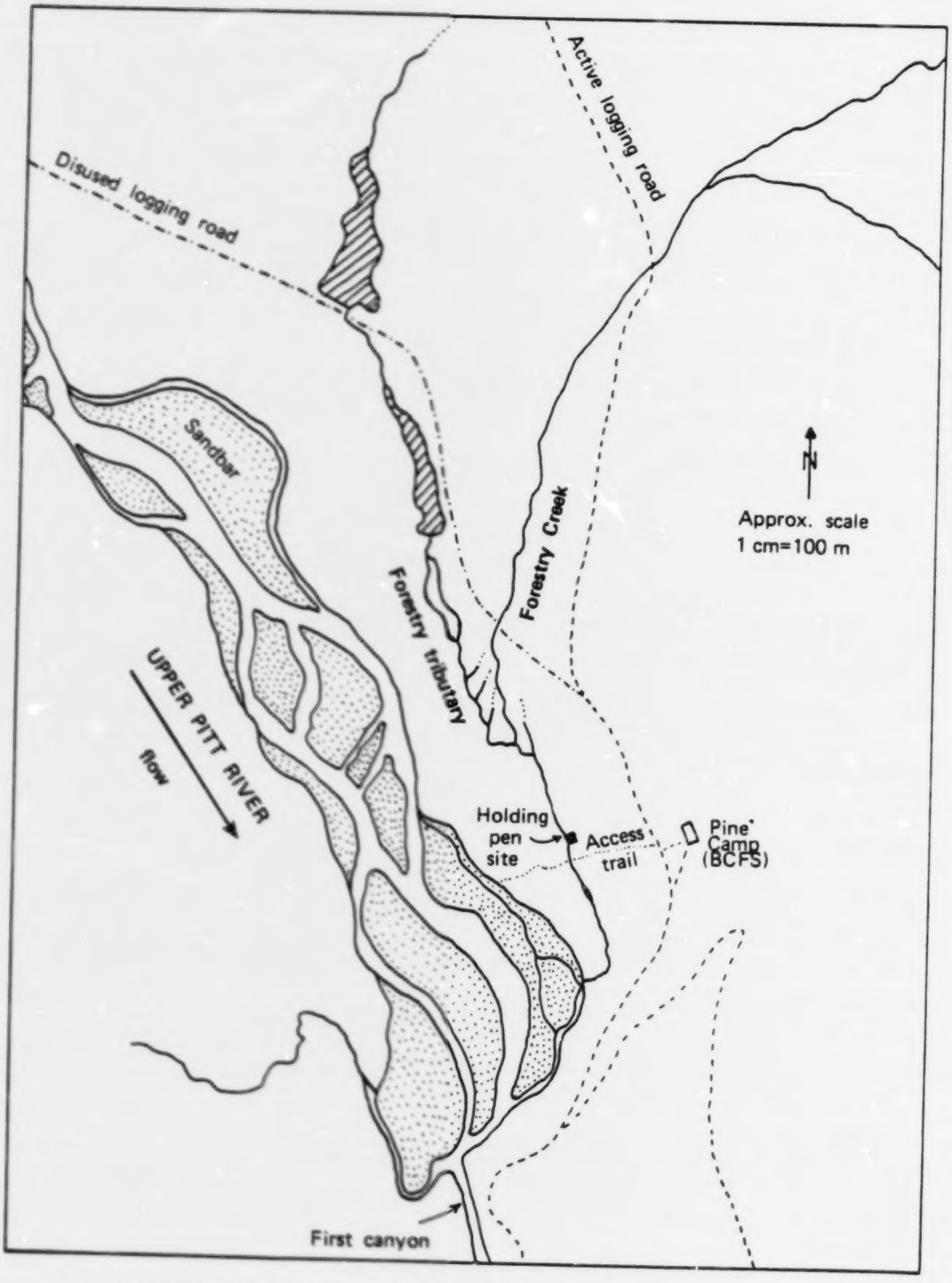
Appendix Fig. 2. Fish Hatchery Creek and the holding pen site in the upper Pitt River system, 1979 and 1980 (diagrammatic).



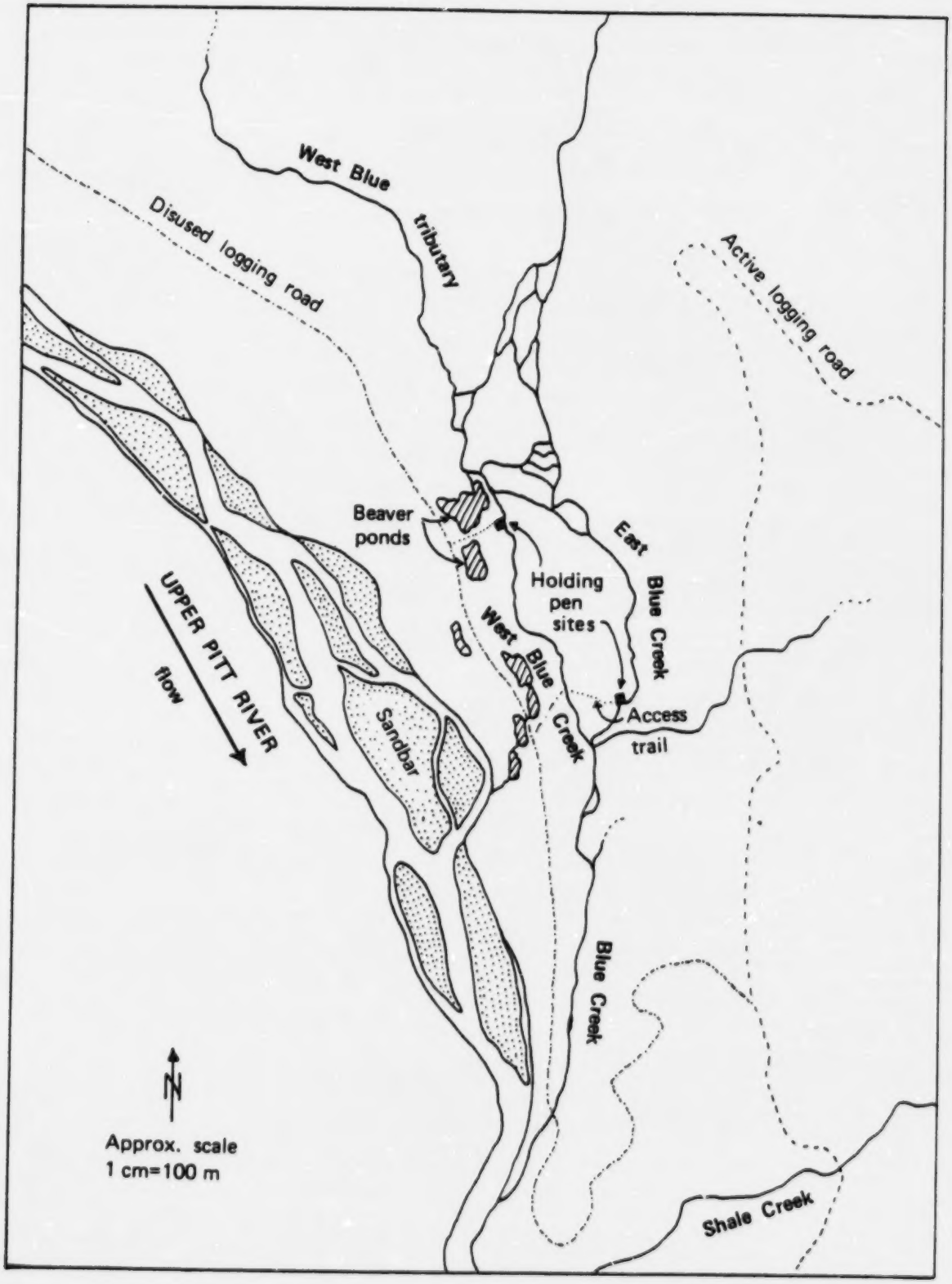
Appendix Fig. 3 . North and South Boise creeks, Boise Flats and the holding pen site in the upper Pitt River system, 1979 and 1980 (diagrammatic).



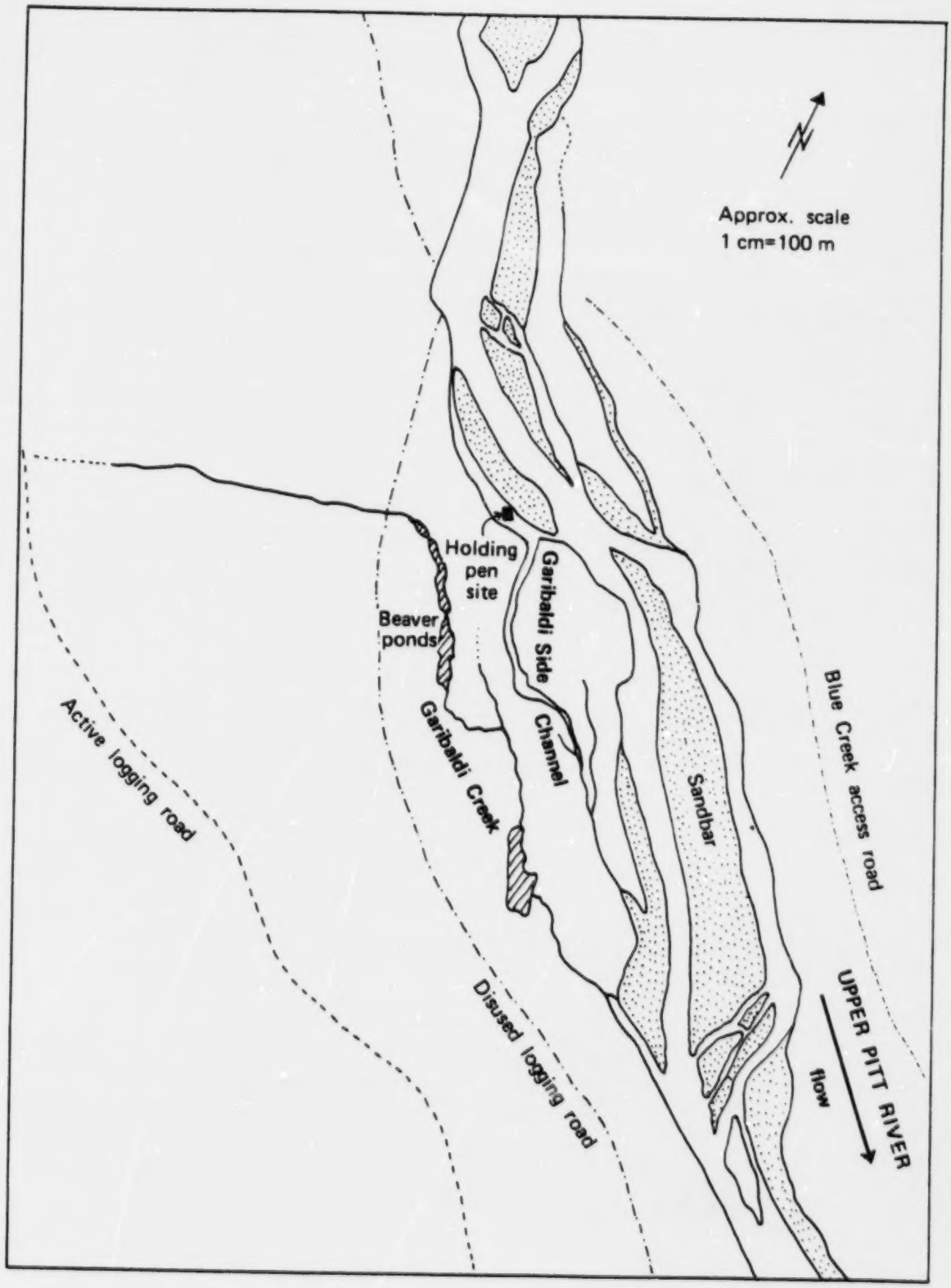
Appendix Fig. 4. Slough Creek and the holding pen site in the upper Pitt River system, 1979 and 1980 (diagrammatic).



Appendix Fig. 5. Forestry Creek and the holding pen site in the upper Pitt River system, 1979 and 1980 (diagrammatic).



Appendix Fig. 6. Blue Creek and the holding pen sites in the upper Pitt River system, 1979 and 1980 (diagrammatic).



Appendix Fig. 7. Garibaldi Creek and the holding pen site in the upper Pitt River system, 1979 and 1980 (diagrammatic).

APPENDIX 1. MONTHLY AND ANNUAL MEAN DAILY DISCHARGES (CUBIC METERS PER SECOND) IN THE UPPER PITT RIVER AT FIRST CANYON (STATION NO. 08MH017), 1952-1965.[1]

	MEAN DAILY DISCHARGE (CMS)													MAXIMUM DAILY DISCHARGE		MINIMUM DAILY DISCHARGE	
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	CMS	DATE	CMS	DATE
1952	-	-	-	-	-	-	-	-	-	34.90	32.50	29.50	-	-	-		
1953	51.20	22.60	19.10	31.60	76.20	87.60	127.00	106.00	78.80	55.50	51.30	31.20	61.80	206.00	JUL 13	8.50	OCT 15
1954	14.30	41.20	16.80	21.10	77.80	104.00	128.00	106.00	90.20	68.60	88.90	26.50	65.40	217.00	OCT 8	7.08	JAN 29
1955	10.60	9.54	7.01	16.40	54.00	124.00	133.00	90.10	63.80	65.10	56.00	16.70	54.10	597.00	NOV 3	5.86	MAR 25
1956	17.90	6.16	11.20	35.90	83.70	110.00	121.00	81.80	67.20	53.40	30.60	22.50	53.60	201.00	SEP 26	5.10	FEB 18
1957	11.00	-	10.80	33.10	109.00	129.00	117.00	75.10	56.40	31.10	16.40	20.80	-	210.00	SEP 6	-	-
1958	23.40	30.70	13.40	20.10	80.10	124.00	99.10	72.20	90.20	-	-	40.00	-	453.00	SEP 17	-	-
1959	26.30	8.72	11.10	28.10	49.00	94.70	98.20	61.50	59.90	44.90	25.80	23.70	44.50	171.00	APR 29	7.79	FEB 18
1960	15.30	19.70	19.80	41.10	60.30	102.00	115.00	74.80	59.10	57.60	36.80	25.10	52.20	165.00	JUN 16	7.05	JAN 10
1961	38.70	26.50	14.70	13.50	46.70	102.00	81.40	51.60	28.80	16.50	11.30	8.73	36.70	232.00	JAN 15	7.65	SEP 26
1962	11.80	19.30	8.41	37.40	48.60	107.00	107.00	104.00	60.00	74.10	58.50	50.70	57.40	231.00	AUG 10	5.80	FEB 27
1963	19.30	60.30	20.40	25.30	58.30	87.50	99.00	75.00	66.60	-	-	-	-	309.00	OCT 13	-	-
1964	19.20	13.50	11.60	23.20	52.40	119.00	170.00	109.00	84.40	66.10	32.50	20.00	60.30	326.00	JUL 15	9.85	MAR 9
1965	14.70	16.40	17.60	34.00	55.00	105.00	98.00	84.10	-	-	-	-	-	-	-	-	-
MEAN	21.05	22.89	13.99	27.75	65.47	107.37	114.90	83.94	67.12	51.62	40.05	26.29	54.00	-	-	-	-

[1] FROM INLAND WATERS DIRECTORATE (1976).

APPENDIX 2. SUMMARY OF SALMON ESCAPEMENTS TO THE UPPER PITT RIVER SYSTEM, 1951 TO 1983 (UNLESS OTHERWISE NOTED. ALL ESTIMATES FROM FISHERY OFFICER FILES).

YEAR	CHINOOK	SOCKEYE ‡	PINK	COHO	CHUM	STEEL-HEAD
1951	750	37837	750	400	1500	200
1952	1500	48899	-	7500	3500	400
1953	1500	18693	7500	3500	1500	750
1954	750	17624	-	400	750	-
1955	750	17950	1500	3500	750	750
1956	1500	32094	-	400	200	400
1957	1500	12338	25	1500	25	400
1958	3500	10385	-	3500	200	-
1959	750	15740	-	400	400	-
1960	400	24510	-	400	-	-
1961	400	11162	2	3500	25	-
1962	3500	16585	-	7500	1500	-
1963	750	12680	-	400	-	-
1964	1500	13804	-	7500	-	-
1965	400	6981	-	1500	-	-
1966	1500	20867	-	3500	75	-
1967	750	10300	-	1500	-	-
1968	400	16988	-	750	-	-
1969	200	25084	-	750	-	-
1970	1500	6657	-	1500	-	-
1971	7500	15469	-	35000	-	-
1972	750	13412	-	1500	-	-
1973	750	11928	-	3500	-	-
1974	500	20792	-	3500	-	-
1975	300	39942	-	3000	-	-
1976	750	36530	-	3500	400	-
1977	700	13887	-	7500‡‡	-	-
1978	150‡‡	24835	-	17500‡‡	25‡‡	-
1979	250‡‡	37558	-	5000‡‡	100‡‡	-
1980	200‡‡	17135	-	2500‡‡	25‡‡	-
1981	325‡‡	25327	-	3500‡‡	25	-
1982	300	8725	-	7500‡‡	-	-
1983	300	16858	-	3500‡‡	10	-
AVERAGE						
51-60	1290	23607	1955	2150	981	483
61-70	1090	14111	0	2840	533	N/R
71-80	1185	23149	0	8250	138	N/R
74-78	480	27197	0	7000	213	N/R
79-83	275	21121	0	4400	40	N/R

‡ IPSFC ESTIMATES.
‡‡ ESTIMATED BY BIOLOGICAL STAFF.

APPENDIX 3. SUMMARY OF LITERATURE ESTIMATES OF OVERWINTERING SURVIVAL OF COHO JUVENILES.

SYSTEM	YEARS ASSESSED	COHO AGE	PERCENT SURVIVAL		FORK LENGTH (MM)		SOURCE	COMMENTS
			MEAN	RANGE	MEAN	RANGE		
WILSON RIVER, OREGON	1951-58	0+	62.2	45.7-91.0	89.4	88.3-95.6	SKEESICK (1970)	FIRST WINTER SURVIVAL OF LATE FALL IMMIGRANTS TO SPRING CREEK, A SMALL WILSON RIVER TRIBUTARY.
CARNATION CREEK, B.C.	1970-81	0+	33.3	16.8-63.4	57.0	47.6-72.4	HOLTBY AND HARTMAN (1982)	ESTIMATE INCLUDES ENTIRE SYSTEM.
CARNATION CREEK, B.C.	1970-81	1+	76.0	27.0-100	81.0	78.5-85.7	HOLTBY AND HARTMAN (1982)	ESTIMATE INCLUDES ENTIRE SYSTEM.
CARNATION CREEK, B.C.	1976-81	0+	72.2	-	-	-	TSCHAPLINSKI AND HARTMAN (1982)	FIRST WINTER SURVIVAL OF LATE FALL IMMIGRANTS TO SMALL TRIBURARIES AND VALLEY SLOUGHS, PRELOGGING
		0+	67.4	-	-	-	-	AS ABOVE, POST LOGGING.
CARNATION CREEK, B.C.	1972-73	0+	61.0 *	-	54.1	-	BUSTARD AND NARVER (1975)	FIRST WINTER SURVIVAL OF LATE FALL IMMIGRANTS TO SMALL TRIBUTARIES AND VALLEY SLOUGHS.

APPENDIX 4a. TAGGING RESULTS FOR AGE 0+ COHO, UPPER PITT RIVER SYSTEM, 1979 (CODE 02 16 62).

LOCATION	TAGGING DATE	MAXIMUM HOLDING TIME (DAYS)	PRE-TAGGING MORTALITY‡	RELEASED WITHOUT TAGGING ‡‡	TOTAL NUMBER MARKED	24 HOUR REJECT RATE		TOTAL MARKED AND WITHOUT TAGS		POST TAGGING MORTALITY		TOTAL RELEASED WITH TAGS
						N ‡‡‡	%	ADIPOSE ONLY	‡‡‡‡TAG LOST	IMMEDIATE	‡‡‡‡‡24 HOUR	
R-400 SIDE CHANNEL	SEP 06	1	28	0	815	815	0.7	0	0	0	116	693
FORESTRY CREEK	SEP 12	2	11	0	2790	672	1.2	9	0	1	0	2747
SLOUGH CREEK	SEP 19	6	15	0	4426	679	0.1	6	0	15	13	4388
SLOUGH CREEK	SEP 26	6	0	0	2671	793	0.5	7	0	0	0	2651
SLOUGH CREEK	OCT 30	7	0	0	2540	0	0.6	4	0	0	0	2521
BOISE FLATS	SEP 24	7	5	3	7160	526	0.2	1	0	0	0	7145
BOISE FLATS	SEP 25	1	0	0	772	353	0.6	1	0	13	0	753
NORTH BOISE CREEK	OCT 01	6	1	3	4415	628	0.6	2	0	5	0	4382
NORTH BOISE CREEK	OCT 02	6	0	0	1414	317	0.3	1	0	0	134	1275
SOUTH BOISE CREEK	OCT 04	4	3	2	5270	671	0.6	0	0	0	0	5238
SOUTH BOISE CREEK	OCT 05	5	1	27	3723	607	0.7	1	0	1	0	3695
SOUTH BOISE CREEK	OCT 10	5	1	6	1866	630	0.6	0	0	0	0	1855
BLUE CREEK	OCT 17	10	5	8	5168	558	1.8	0	0	0	0	5075
BLUE CREEK	OCT 18	11	2	12	5195	481	0.6	8	0	0	11	5145
GARABALDI CREEK	OCT 29	2	0	0	1853	0	0.6	1	0	1	0	1840
FISH HATCHERY CR.	OCT 30	3	0	2	1465	0	0.6	0	0	0	0	1456
PETER'S SLOUGH	OCT 30	1	2	5	9050	300	0.3	0	0	1	0	9022
PETER'S SLOUGH	NOV 01	2	1	1	2515	0	0.6	0	0	1	0	2499
TOTAL	-	-	75	69	63108	8030	0.6	41	375	38	274	62380

‡ SACRIFICED FOR TAG PLACEMENT ASSESSMENT.
‡‡ ANOMALIES (SEE APPENDIX 5) AND UNDERSIZED (<45 MM) FISH.
‡‡‡ SIZE OF SAMPLE HELD FOR TAG LOSS AND MORTALITY ASSESSMENT.
‡‡‡‡ BASED ON APPLICATION OF % REJECT RATE TO ENTIRE TAG LOT.
‡‡‡‡‡ MORTALITY RATE IN QCD SAMPLE APPLIED TO ENTIRE TAG LOT.

APPENDIX 4b. TAGGING RESULTS FOR AGE 1+ COHO, UPPER PITT RIVER SYSTEM, 1979 (CODE 02 16 60).*

LOCATION	TAGGING DATE	MAXIMUM HOLDING TIME (DAYS)	PRE-TAGGING MORTALITY*	RELEASED WITHOUT TAGGING **	TOTAL NUMBER MARKED	24 HOUR REJECT RATE		TOTAL MARKED AND WITHOUT TAGS		POST TAGGING MORTALITY		TOTAL RELEASED WITH TAGS
						N ***	%	ADIPOSE ONLY	****TAG LOST	IMMEDIATE	*****24 HOUR	
FORESTRY CREEK	SEP 13	5	1	0	104	0	1.24	0	1	0	0	103
SLOUGH CREEK	SEP 19	6	3	2	947	251	8.80	2	83	0	0	862
SLOUGH CREEK	SEP 26	6	0	0	1145	569	0.70	8	7	0	0	1130
SLOUGH CREEK	OCT 30	7	0	0	1469	0	1.24	0	18	0	0	1451
BOISE FLATS	SEP 25	7	6	1	2206	537	0.30	1	7	0	0	2198
NORTH BOISE CREEK	OCT 02	7	0	6	3105	612	0.50	3	16	3	50	3033
SOUTH BOISE CREEK	OCT 04	4	0	3	1464	557	0.20	0	3	0	0	1461
SOUTH BOISE CREEK	OCT 05	5	0	2	856	289	2.40	1	20	1	3	831
SOUTH BOISE CREEK	OCT 10	5	0	0	279	279	0.00	0	0	0	0	279
BLUE CREEK	OCT 17	10	5	9	3171	337	1.50	0	48	0	0	3123
BLUE CREEK	OCT 18	11	2	4	2796	354	0.80	0	22	0	0	2774
GARABALDI CREEK	OCT 29	2	0	0	513	0	1.24	0	6	0	0	507
FISH HATCHERY CR.	OCT 30	3	0	0	205	0	1.24	0	3	0	0	202
PETER'S SLOUGH	NOV 01	2	3	0	1105	0	1.24	0	14	0	0	1091
TOTAL	-	-	20	27	19365	3785	1.24	15	248	4	53	19045

* SEE APPENDIX 4a FOR FOOTNOTE NOTATIONS.

APPENDIX 4c. TAGGING RESULTS FOR AGE 0+ COHO, UPPER FITT RIVER SYSTEM, 1980 (CODE 02 18 03).*

LOCATION	TAGGING DATE	PRE-TAGGING MORTALITY*	RELEASED WITHOUT TAGGING**	TOTAL NUMBER MARKED	24 HOUR REJECT RATE N***	24 HOUR REJECT RATE %	TOTAL MARKED AND WITHOUT TAGS ADIPOSE ONLY	TOTAL MARKED AND WITHOUT TAGS ***TAG LOST	POST TAGGING MORTALITY IMMEDIATE	POST TAGGING MORTALITY ***24 HOUR	TOTAL RELEASED WITH TAGS
FORESTRY CREEK	SEP 05	5	13	3449	0	0.3	8	10	4	0	3427
FORESTRY CREEK	SEP 06	1	0	104	0	0.3	0	0	0	0	104
FISH HATCHERY CR.	SEP 07	3	33	3771	307	0.0	2	0	10	25	3734
FISH HATCHERY CR.	SEP 08	1	52	2080	380	0.3	0	6	10	39	2025
FISH HATCHERY CR.	SEP 09	5	8	1566	361	0.3	0	5	2	40	1519
FISH HATCHERY CR.	SEP 10	1	2	742	244	0.0	0	0	5	3	734
PETER'S SLOUGH	SEP 11	1	0	686	365	0.3	0	2	0	0	684
PETER'S SLOUGH	SEP 12	7	11	2270	437	0.0	3	0	0	6	2261
PETER'S SLOUGH	SEP 13	1	21	4591	408	0.0	2	0	0	1	4589
PETER'S SLOUGH	SEP 14	1	40	1592	423	0.0	0	0	0	5	1587
GARABALDI CREEK	SEP 17	0	8	3616	362	1.9	2	69	3	0	3542
GARABALDI CREEK	SEP 18	3	3	3358	354	0.0	0	0	2	2	3354
SLOUGH CREEK	SEP 22	1	10	1622	271	0.0	7	0	0	1	1614
SLOUGH CREEK	SEP 23	2	36	3714	335	0.0	13	0	0	0	3701
SLOUGH CREEK	SEP 24	9	11	1788	473	0.8	2	14	0	0	1772
SLOUGH CREEK	SEP 25	0	21	2461	542	0.6	4	15	0	4	2438
SLOUGH CREEK	SEP 27	1	13	1153	325	0.3	0	3	0	0	1150
SLOUGH CREEK	SEP 28	2	10	564	0	0.3	0	2	0	0	562
BOISE FLATS	OCT 01	1	12	4010	306	0.3	1	12	0	1	3996
BOISE FLATS	OCT 02	3	10	2418	0	0.3	1	7	0	0	2410
BOISE FLATS	OCT 06	2	16	2946	414	0.2	3	6	0	1	2935
BOISE FLATS	OCT 07	2	3	1217	325	0.6	1	7	1	0	1208
NORTH BOISE CREEK	OCT 07	2	484**	3503	356	0.3	1	11	0	0	3491
NORTH BOISE CREEK	OCT 08	1	976**	5332	369	0.5	0	27	2	2	5301
NORTH BOISE CREEK	OCT 09	1	1079**	2054	248	0.0	0	0	1	0	2053
NORTH BOISE CREEK	OCT 10	2	938**	718	717	0.0	0	0	0	1	717
SOUTH BOISE CREEK	OCT 11	1	9	2240	508	1.2	0	27	0	0	2213
SOUTH BOISE CREEK	OCT 12	1	2	133	0	0.3	0	0	0	0	133
BLUE CREEK	OCT 16	3	42	4396	529	0.0	1	0	0	0	4395
BLUE CREEK	OCT 17	1	0	326	326	0.0	0	0	0	0	326
BLUE CREEK	OCT 20	2	163	2503	0	0.3	10	8	0	0	2485
TOTAL	-	66	4026	70923	9685	0.3	61	231	40	131	70660

* SEE APPENDIX 4a FOR FOOTNOTE NOTATIONS.
** RELEASED UNTAGGED IN ORDER TO PROVIDE SUFFICIENT TAGS FOR BLUE CREEK.

APPENDIX 4d. TAGGING RESULTS FOR AGE 1+ COHO, UPPER PITT RIVER SYSTEM, 1980 (CODE 02 18 02).‡

LOCATION	TAGGING DATE	PRE-TAGGING MORTALITY‡	RELEASED WITHOUT TAGGING ‡‡	TOTAL NUMBER MARKED	24 HOUR REJECT RATE N ‡‡‡	24 HOUR REJECT RATE %	TOTAL MARKED AND WITHOUT TAGS ADIPOSE ONLY	TOTAL MARKED AND WITHOUT TAGS ‡‡‡‡TAG LOST	POST TAGGING MORTALITY IMMEDIATE	POST TAGGING MORTALITY ‡‡‡‡‡24 HOUR	TOTAL RELEASED WITH TAGS
FORESTRY CREEK	SEP 06	4	0	122	0	1.40	0	2	0	0	120
FISH HATCHERY CR.	SEP 08	3	7	740	216	0.90	0	7	0	2	731
FISH HATCHERY CR.	SEP 09	1	0	93	0	1.40	0	1	0	4	88
FISH HATCHERY CR.	SEP 10	0	1	21	0	1.40	0	0	0	0	21
PETER'S SLOUGH	SEP 14	1	1	1008	341	0.60	0	6	0	1	1001
GARABALDI CREEK	SEP 18	5	2	769	324	0.60	0	5	0	0	764
SLOUGH CREEK	SEP 24	0	1	1098	197	0.00	0	0	0	0	1098
SLOUGH CREEK	SEP 27	1	4	677	250	0.00	2	0	0	0	675
SLOUGH CREEK	SEP 28	1	6	974	0	1.40	6	14	0	0	954
BOISE FLATS	OCT 02	1	10	1528	302	11.60	0	177	0	0	1351
BOISE FLATS	OCT 06	1	3	430	325	0.00	0	0	0	0	430
NORTH BOISE CREEK	OCT 09	0	4	1274	314	0.00	1	0	0	0	1273
NORTH BOISE CREEK	OCT 10	0	6	2510	219	0.00	0	0	0	0	2510
SOUTH BOISE CREEK	OCT 12	1	5	1478	0	1.40	4	21	2	0	1451
BLUE CREEK	OCT 17	1	3	1969	302	0.70	0	14	2	0	1953
BLUE CREEK	OCT 20	2	0	999	354	0.60	0	6	0	0	993
TOTAL	-	22	53	15690	3144	1.40	13	253	4	7	15413

‡ SEE APPENDIX 4a FOR FOOTNOTE NOTATIONS.

APPENDIX 4e. RECAPTURES OF TAGGED COHO JUVENILES IN THE UPPER PITT RIVER SYSTEM, 1979 AND 1980.

YEAR	LOCATION	AGE 0+			AGE 1+		
		NUMBER RECAPTURED	NUMBER WITHOUT CWT	CWT LOSS RATE (%)	NUMBER RECAPTURED	NUMBER WITHOUT CWT	CWT LOSS RATE (%)
1979	PETER'S SLOUGH	216	9	4.17	19	1	5.26
	FISH HATCHERY CREEK	9	0	0.00	0	0	-
	NORTH BOISE CREEK	99	3	3.03	2	1	50.00
	SOUTH BOISE CREEK	28	1	3.57	13	0	0.00
	BOISE FLATS	15	0	0.00	0	0	-
	SLOUGH CREEK	241	4	1.66	0	0	-
	SLOUGH CREEK	59	0	0.00	147	15	10.20
	TOTAL	667	17	2.55	181	17	5.98
1980	PETER'S SLOUGH	0	0	-	99	5	5.05
	FISH HATCHERY CREEK	0	0	-	14	2	14.29
	NORTH BOISE CREEK	64	3	4.69	207	19	9.18
	SOUTH BOISE CREEK	6	2	33.33	392	66	16.84
	BOISE FLATS	51	1	1.96	755	15	1.99
	SLOUGH CREEK	0	0	-	302	39	12.91
	BLUE CREEK	1	0	0.00	476	77	16.18
	GARIBALDI CREEK	0	0	-	290	10	3.45
	TOTAL	122	6	4.92	2535	233	9.19

‡ SLOUGH CREEK DATA DELETED IN ORDER TO ELIMINATE BIAS FROM ATYPICAL SEPTEMBER 19 SHORT TERM TAG LOSS RATE OF 8.3% (APPENDIX 4b).

APPENDIX 5a. ANOMALIES ENCOUNTERED DURING TAGGING OF COHO JUVENILES IN THE UPPER PITT RIVER SYSTEM, 1979 (FIRST NUMBER INDICATES MINOR ANOMALIES RELEASED TAGGED; SECOND NUMBER INDICATES SEVERE ANOMALIES RELEASED UNTAGGED).

LOCATION	TAGGING DATE	NUMBER IN-SPECTED	FOG EYE	POP EYE	EYE DAMAGE	TAIL ROT	JAW DAMAGE	NOSE DAMAGE	OPER-CULUM DAMAGE	FUNGUS	SCALE LOSS	LOR-DOSIS	SCOLI-OSIS	NATUR-ALLY MISSING ADIPOSE	TOTAL
						AGE 0+									
R-400 SIDE CHAN.	SEP 6	843	-	-	-	-	-	-	-	-	-	-	-	-	-
FORESTRY CREEK	SEP 12	2801	-	-	-	-	1/0	-	-	-	-	-	-	-	-
SLOUGH CREEK	SEP 19	4441	-	-	-	3/0	1/0	1/0	-	-	-	3/0	-	-	-
BOISE FLATS	SEP 24,25	7940	-	-	1/2	3/1	-	-	-	-	-	-	-	-	-
SLOUGH CREEK	SEP 26	2671	-	-	-	1/0	-	-	-	-	-	-	-	-	-
N BOISE CREEK	OCT 1,2	5833	1/1	1/0	1/0	12/0	-	-	2/0	0/2	-	-	-	-	-
S BOISE CREEK	OCT 4,5,10	10899	2/3	-	0/1	3/2	-	-	-	-	0/2	-	-	-	-
BLUE CREEK	OCT 17,18	10390	2/0	2/1	-	25/4	-	-	7/1	-	0/2	8/1	1/2	1/0	-
GARIBALDI CREEK	OCT 29	1853	-	-	-	-	-	-	-	-	-	-	-	-	-
SLOUGH CREEK	OCT 30	2540	-	-	-	3/0	-	-	-	-	-	2/0	-	-	-
FISH HATCHERY CR.	OCT 30	1467	-	1/0	-	1/0	-	-	-	-	0/1	33/1	-	-	-
PETER'S SLOUGH	OCT 31,NOV 1	11574	-	1/0	0/1	9/1	-	-	-	-	2/4	1/0	-	1/0	-
TOTAL		63252	5/4	5/1	2/4	60/8	2/0	1/0	9/1	0/2	2/9	47/2	1/2	2/0	136/33
% INCIDENCE		100	0.01	.01	0.01	0.11	0	0	0.02	0	0.02	0.08	0	0	0.27
						AGE 1+									
FORESTRY CREEK	SEP 13	105	-	-	-	-	-	-	-	-	-	-	-	-	-
SLOUGH CREEK	SEP 19	952	2/0	1/0	0/1	0/1	-	69/0	-	-	-	-	-	-	-
BOISE FLATS	SEP 25	2213	2/0	-	1/0	2/0	2/0	374/1	-	-	-	2/0	-	-	-
SLOUGH CREEK	SEP 26	1145	1/0	-	-	-	1/0	-	-	-	-	3/0	1/0	-	-
N BOISE CREEK	OCT 2	3111	6/0	-	-	3/2	1/0	160/3	1/0	2/0	0/1	-	-	-	-
S BOISE CREEK	OCT 4,5,10	2604	3/0	0/1	0/3	1/0	-	1/0	1/0	-	0/1	1/0	-	-	-
BLUE CREEK	OCT 17,18	5987	1/0	2/1	-	14/1	-	-	7/0	-	0/5	1/1	0/5	-	-
GARIBALDI CREEK	OCT 29	513	-	-	-	-	-	-	-	-	-	-	-	-	-
SLOUGH CREEK	OCT 30	1469	3/0	1/0	-	3/0	2/0	-	-	-	-	-	-	-	-
FISH HATCHERY CR.	OCT 30	205	-	-	-	-	-	-	-	-	-	-	-	-	-
PETER'S SLOUGH	NOV 1	1108	1/0	-	-	-	-	-	-	-	-	1/0	-	-	-
TOTAL		19412	19/0	4/2	1/4	23/4	6/0	604/4	9/0	2/0	0/7	8/1	1/5	0	677/27
% INCIDENCE		100	0.10	0.03	0.03	0.14	0.03	3.13	0.05	0.01	0.04	0.05	0.03	0	3.63

APPENDIX 5b. ANOMALIES ENCOUNTERED DURING TAGGING OF COHO JUVENILES IN THE UPPER PITT RIVER SYSTEM, 1980 (FIRST NUMBER INDICATES MINOR ANOMALIES RELEASED TAGGED; SECOND NUMBER INDICATES SEVERE ANOMALIES RELEASED UNTAGGED).

LOCATION	TAGGING DATE	NUMBER INSPECTED	FOG EYE	POP EYE	BLOOD EYE	EYE DAMAGE	TAIL ROT	TAIL DAMAGE	JAW DAMAGE	NOSE DAMAGE	OPERCULUM DAMAGE	GENERAL DAMAGE	TUMOR	DEFORMATION	SCALE LOSS	LORDOSIS	SCOLIOSIS	NATURALLY MISSING ADIPOSE	TOTAL
								AGE 0+											
FORESTRY CREEK	SEP 5	3572	-	0/1	-	-	1/0	-	-	-	-	-	-	-	-	-	-	-	-
FISH HATCHERY CR.	SEP 7-10	8264	-	0/1	-	-	-	-	-	-	-	0/3	0/1	-	0/2	14/12	1/3	-	-
PETER'S SLOUGH	SEP 12-13	9221	-	-	2/0	-	0/5	-	-	-	-	1/3	-	-	0/8	-	-	-	-
GARIBALDI CREEK	SEP 17-18	6988	-	-	-	-	3/0	-	-	-	-	0/5	-	-	-	1/0	-	1/0	-
SLOUGH CREEK	SEP 22-28	11418	-	0/3	1/0	1/0	2/1	-	-	-	1/0	0/3	1/1	0/1	0/23	2/3	0/1	2/0	-
BOISE FLATS	OCT 1- 7	10640	1/0	0/3	-	-	1/0	-	-	-	0/3	1/3	-	-	0/6	0/1	-	-	-
N BOISE CREEK	OCT 7-10	15090	1/0	0/2	-	-	1/1	-	-	-	1/0	0/5	-	0/1	1/14	-	-	-	-
S BOISE CREEK	OCT 11	2386	0/1	-	-	-	-	-	-	-	0/1	-	-	-	0/7	-	-	-	-
BLUE CREEK	OCT 16,20	7436	2/3	0/3	-	-	-	-	-	-	-	-	-	-	0/3	0/2	0/3	-	-
TOTAL		75015	4/4	0/13	3/0	1/0	8/7	0	0	0	2/4	2/22	1/2	0/2	1/63	17/18	1/7	3/0	43/142
% INCIDENCE		100	0.01	0.02	0	0	0.02	0	0	0	0.01	0.03	0	0	0.09	0.05	0.01	0	0.25
								AGE 1+											
FORESTRY CREEK	SEP 6	126	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FISH HATCHERY CR.	SEP 8,10	866	-	0/2	-	-	-	1/0	0/1	-	-	0/1	-	-	2/0	0/2	0/2	1/0	-
PETER'S SLOUGH	SEP 14	1010	-	-	-	-	0/1	-	-	-	-	-	-	-	-	-	-	-	-
GARIBALDI CREEK	SEP 18	776	-	-	-	-	1/0	-	-	-	-	0/1	-	-	0/1	-	-	1/0	-
SLOUGH CREEK	SEP 24-28	2762	2/0	-	-	1/0	2/0	-	-	-	2/0	2/5	-	0/1	0/2	5/3	-	1/0	-
BOISE FLATS	OCT 2,6	1973	2/0	-	-	0/1	1/2	-	-	-	-	0/6	-	-	0/3	-	0/1	-	-
N BOISE CREEK	OCT 9,10	3794	1/1	-	-	1/0	1/1	-	-	34/0	1/0	0/3	-	-	1/3	-	0/2	-	-
S BOISE CREEK	OCT 12	1484	0/1	-	-	-	-	-	-	-	-	-	-	-	0/4	-	-	-	-
BLUE CREEK	OCT 17,20	2974	0/2	0/2	-	-	-	-	-	-	1/0	1/0	-	-	0/4	-	-	2/0	-
TOTAL		15765	5/4	0/4	0	2/1	5/4	1/0	0/1	34/0	4/0	3/16	0	0/1	3/17	5/5	0/5	5/0	67/58
% INCIDENCE		100	0.06	0.03	0	0.02	0.06	0.01	0.01	0.22	0.03	0.12	0	0.01	0.13	0.06	0.03	0.03	0.79

APPENDIX 8a. LENGTH FREQUENCY DISTRIBUTION BY AGE (0+ AND 1+) AND CAPTURE SITE OF COHO JUVENILES RELEASED WITH CODED WIRE TAGS IN THE UPPER PAYETTE RIVER SYSTEM, 1979, AND PROPORTIONS OF THE AGE CLASSES WITH 0+ AND 1+ CODES.

CAPTURE SITE:	R-400 SIDE CHAN			FORESTRY CREEK			SLOUGH CREEK			BOISE FLATS			SLOUGH CREEK			N BOISE CREEK			S BOISE CREEK		
DATE:	SEP 6			SEP 12			SEP 19			SEP 24			SEP 26			OCT 2			OCT 4		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																					
36-40	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41-45	-	-	-	2	-	2	3	-	3	1	-	1	8	-	8	1	-	2	2	-	2
46-50	4	-	3	6	-	6	5	-	5	8	-	8	2	-	3	3	-	5	4	-	5
51-55	6	-	7	11	-	13	7	-	7	7	-	7	6	-	10	3	-	5	3	-	5
56-60	5	-	5	9	-	9	6	-	6	6	-	6	4	1	5	6	1	9	5	-	-
61-65	2	-	2	10	-	10	2	-	2	3	-	3	-	-	-	2	3	7	2	-	4
66-70	3	-	3	2	-	2	2	1	3	3	1	4	2	2	5	-	-	2	1	-	5
71-75	4	-	4	3	-	3	1	3	4	1	4	6	-	-	1	-	1	1	-	2	2
76-80	-	-	-	1	-	2	1	5	6	1	4	7	1	2	6	-	1	4	1	2	4
81-85	-	-	-	-	-	-	-	4	6	-	1	5	-	3	5	-	2	5	-	-	1
86-90	-	-	-	1	-	1	-	4	3	-	-	-	1	4	6	-	1	6	-	2	4
91-95	-	-	-	-	-	-	-	1	2	-	2	2	-	1	1	-	1	3	-	2	2
96-100	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	2	2	-	1	1
101-105	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	3
106-110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121-125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
TOTAL	25	0	25	47	0	50	27	21	50	39	12	50	26	13	50	15	12	51	18	13	31
NO. TAGGED WITH 0+ CODE (82 TO 83)	25	0	-	47	0	-	25	0	-	25	0	-	23	0	-	14	0	-	16	0	-
NO. TAGGED WITH 1+ CODE (82 TO 83)	0	0		0	0	-	2	21	-	4	12	-	3	13	-	1	12	-	2	13	

* DETAILS OF STRATEGIES IN CODED WIRE TAG RELEASES FOR 1979 ARE PRESENTED IN...

APPENDIX 6a. (CON'T).

CAPTURE SITE:	BLUE CREEK			GARIBALDI CREEK			SLOUGH CREEK			FISH HATCHERY CR			PETER S SLOUGH			TOTAL		
DATE:	OCT 17			OCT 29			OCT 30			OCT 30			NOV 1					
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
36-40	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3
41-45	4	-	4	1	-	1	8	-	8	2	-	2	2	-	2	34	0	35
46-50	9	-	9	7	-	7	5	-	5	2	-	3	1	-	1	58	0	62
51-55	8	-	8	7	-	8	2	-	2	3	-	4	11	-	11	76	0	87
56-60	2	-	2	7	2	9	8	-	8	6	1	8	3	1	4	67	6	78
61-65	-	-	-	3	-	3	1	-	1	2	1	5	3	-	4	30	4	41
66-70	2	2	4	5	1	6	-	1	1	-	1	3	2	-	3	22	9	41
71-75	2	3	5	1	5	7	1	-	3	-	-	-	-	-	-	13	18	36
76-80	2	5	10	1	3	4	-	1	5	-	-	-	2	3	6	10	26	54
81-85	-	2	2	-	3	3	-	3	8	-	-	-	-	2	5	0	20	40
86-90	-	1	2	-	1	2	-	1	6	-	-	-	1	1	4	3	15	34
91-95	-	1	1	-	-	-	-	-	2	-	-	-	-	3	4	0	11	18
96-100	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0	7	9
101-105	-	-	-	-	-	-	-	1	1	-	-	-	-	2	2	0	6	9
106-110	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	0	2	2
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0	1	1
121-125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1
TOTAL	31	14	49	32	15	50	25	7	50	15	3	25	25	16	50	316	126	551
NO. TAGGED WITH 0+ CODE (02 16 62)	25	0	-	23	1	-	24	0	-	15	3	-	22	1	-	284	5	-
NO. TAGGED WITH 1+ CODE (02 16 60)	6	14	-	9	14	-	1	7	-	0	0	-	3	15	-	32	121	-

% OF 0+ FISH TAGGED CORRECTLY: (284/316)*100 = 89.9%.
% OF 1+ FISH TAGGED CORRECTLY: (121/126)*100 = 96.0%.

*AGE 0+ CODE (02 16 62): 98.7% AGE 0+
*AGE 1+ CODE (02 16 60): 80.6% AGE 1+

* WEIGHTED BY STUDY AREA TAG LOT SIZE.

APPENDIX 6b. LENGTH FREQUENCY DISTRIBUTION BY AGE (0+ AND 1+) AND CAPTURE SITE OF COHO JUVENILES RELEASED WITH CODED WIRE TAGS IN THE UPPER PITT RIVER SYSTEM, 1980, AND PROPORTIONS OF THE AGE CLASSED TAGGED WITH 0+ AND 1+ CODES.&

CAPTURE SITE:	FORESTRY CREEK			FISH HATCHERY CR			PETER'S SLOUGH			GARIBALDI CREEK			SLOUGH CREEK			BOISE FLATS		
DATE:	SEP 5			SEP 8			SEP 14			SEP 18			SEP 28			OCT 2		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
36-40	2	-	2	1	-	1	-	-	-	1	-	1	-	-	-	-	-	-
41-45	5	-	5	5	-	5	3	-	3	3	-	3	9	-	9	1	-	1
46-50	3	-	6	6	-	6	5	-	5	9	-	9	5	-	5	8	-	8
51-55	5	-	5	9	-	10	6	-	6	7	-	7	5	-	5	7	-	7
56-60	6	-	7	-	-	-	6	-	6	5	-	5	2	-	2	5	-	5
61-65	-	-	-	2	-	2	4	-	4	-	-	-	2	3	5	4	-	4
66-70	-	1	1	3	2	5	1	-	1	-	-	-	1	4	6	-	1	1
71-75	-	4	5	3	3	6	1	1	2	3	1	5	-	6	6	1	4	5
76-80	-	6	7	-	3	3	1	3	4	1	4	7	-	6	6	-	4	6
81-85	-	8	8	1	3	4	-	3	3	-	4	6	-	4	4	-	5	5
86-90	-	3	3	-	1	1	2	6	8	-	2	2	-	1	1	-	3	4
91-95	-	-	-	-	1	1	-	4	4	-	-	1	-	1	1	-	1	1
96-100	-	1	1	-	1	1	-	4	4	-	1	2	-	-	-	-	1	1
101-105	-	-	-	-	2	2	-	-	-	-	1	2	-	-	-	-	2	2
106-110	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	21	23	50	30	19	50	29	21	50	29	13	50	24	25	50	26	21	50
NO. TAGGED WITH 0+ CODE (02 18 03)	21	0	-	23	1	-	25	0	-	25	0	-	24	1	-	25	0	-
NO. TAGGED WITH 1+ CODE (02 18 02)	0	23	-	7	18	-	4	21	-	4	13	-	0	24	-	1	21	-

& OCCASIONAL DISCREPANCY IN COLUMN ADDITION DUE TO SCALE REGENERATION.

CONTINUED

APPENDIX 6b. (CONT).

CAPTURE SITE: / DATE:	N BOISE CREEK OCT 9			S BOISE CREEK OCT 12			BLUE CREEK OCT 17			TOTAL		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)												
36-40	-	-	-	-	-	-	1	-	1	5	0	5
41-45	-	-	-	2	-	2	5	-	5	33	0	33
46-50	6	-	6	11	-	12	10	-	10	63	0	67
51-55	6	-	9	7	-	7	4	-	4	56	0	60
56-60	9	-	9	2	-	2	4	-	4	39	0	40
61-65	2	-	2	2	-	2	1	-	1	17	3	20
66-70	-	2	2	-	4	4	-	2	2	5	16	22
71-75	-	3	3	-	7	7	-	1	2	8	30	41
76-80	-	5	5	-	8	8	-	8	9	2	47	55
81-85	-	4	4	-	1	1	-	5	8	1	37	43
86-90	-	5	6	-	3	3	-	2	2	2	26	30
91-95	-	3	3	-	2	2	-	-	2	0	12	15
96-100	-	2	2	-	-	-	-	-	-	0	10	11
101-105	-	-	-	-	-	-	-	-	-	0	5	6
106-110	-	-	-	-	-	-	-	-	-	0	2	2
111-115	-	-	-	-	-	-	-	-	-	0	0	0
116-120	-	-	-	-	-	-	-	-	-	0	1	1
TOTAL	23	24	51	24	25	50	25	18	50	231	189	451
NO. TAGGED WITH 0+ CODE (02 18 03)	23	0	-	24	0 *	-	25	0	-	215	2	-
NO. TAGGED WITH 1+ CODE (02 18 02)	0	24	-	0	25	-	0	18	-	16	187	-

% OF 0+ FISH TAGGED CORRECTLY: (215/231)*100 = 93.1%
% OF 1+ FISH TAGGED CORRECTLY: (187/189)*100 = 98.9%

*AGE 0+ CODE (02 18 03): 98.9% AGE 0+
*AGE 1+ CODE (02 18 01): 95.7% AGE 1+

* WEIGHTED BY STUDY AREA TAG LOT SIZE.

APPENDIX 7a. TRAPPING EFFORT AND CATCH RESULTS IN NORTH BOISE CREEK, 1979 AND 1980.

YEAR	DATE	NO. TRAPS	HOURS SET	COHO CATCH			SAMPLE RESULTS: AGE		SAMPLE RESULTS: % MARKED		ESTIMATED MEAN CATCH PER TRAP		
				MARKED	UNMARKED	TOTAL	0+	1+	0+	1+	TOTAL	AGE 0+	AGE 1+
1979	JUL 17	6	24	-	217	217	3	87	0.00	0.00	36.17	1.21	34.96
	AUG 2	5	24	-	210	210	28	72	0.00	0.00	42.00	11.76	30.24
	AUG 16	4	24	-	196	196	15	86	0.00	0.00	49.00	7.28	41.72
	SEP 7	2	12	-	92	92	4	14	0.00	0.00	46.00	10.22	35.78
	SEP 13	2	12	-	76	76	12	33	0.00	0.00	38.00	10.13	27.87
	OCT 20	2	12	48	127	175	23	6	52.17	33.33	87.50	69.40	18.10
	NOV 14	7	4	51	132	183	35	0	28.57	0.00	26.14	26.14	0.00
	TOTAL	-	-	99	1050	1149	120	298	37.93**	33.33**	41.04	11.78	29.26
1980	AUG 6	2	5	5	58	63	3	34	0.00	11.76	31.50	2.55	28.95
	AUG 14	2	6	11	117	128	17	33	0.00	18.18	64.00	21.76	42.24
	AUG 20	2	6	1	100	101	21	25	0.00	4.00	50.50	23.05	27.45
	SEP 3	2	8	3	146	149	39	8	0.00	0.00	74.50	61.82	12.68
	SEP 11	2	24	4	114	118	37	11	0.00	9.09	59.00	45.48	13.52
	SEP 23	2	24	3	127	130	32	16	0.00	12.50	65.00	43.33	21.67
	OCT 1	2	24	2	54	56	21	11	0.00	0.00	28.00	18.38	9.63
	OCT 15	2	24	40	50	90	36	8	33.33	50.00	45.00	36.82	8.18
	OCT 22	2	18	57	52	109	36	10	58.33	80.00	54.50	42.65	11.85
	NOV 19	2	18	36	27	63	9	38	55.56	57.89	31.50	6.03	25.47
	TOTAL	-	-	162	845	1007	251	194	0.00* 46.91**	10.14* 60.71**	50.35	28.40	21.95

* PRIOR TO FIRST RELEASE OF CWT'S THAT YEAR.
** AFTER FIRST RELEASE OF CWT'S THAT YEAR.

APPENDIX 7b. LENGTH FREQUENCY DISTRIBUTION BY AGE (0+ AND 1+) OF COHO JUVENILES MINNOW TRAPPED IN NORTH BOISE CREEK, JULY - NOVEMBER 1979.*

DATE:	JULY 17			AUG 2			AUG 16			SEP 7			SEP 13			OCT 20			NOV 14			TOTAL		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																								
36-40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
41-45	-	-	-	4	-	4	1	-	1	-	-	-	5	-	5	1	-	1	1	-	1	12	0	12
46-50	-	-	-	2	-	2	3	-	3	-	-	-	5	-	5	7	-	10	6	-	6	23	0	26
51-55	-	1	1	2	-	2	-	-	-	1	-	1	7	-	8	8	1	13	16	-	20	34	2	45
56-60	2	8	10	8	1	9	4	2	6	-	-	-	14	-	14	3	-	6	10	-	17	41	11	62
61-65	1	20	21	9	15	27	5	10	15	2	1	3	1	-	2	1	-	4	1	-	2	20	46	74
66-70	-	22	22	2	18	23	2	20	24	-	3	5	1	2	5	1	-	3	1	-	1	7	65	83
71-75	-	16	16	1	14	17	-	21	23	1	4	6	-	4	5	2	1	4	-	-	1	4	60	72
76-80	-	13	14	-	11	12	-	12	14	-	3	5	-	6	6	-	1	2	-	-	1	0	46	54
81-85	-	4	4	-	6	6	-	7	7	-	3	4	-	-	-	-	-	2	-	-	1	0	20	24
86-90	-	1	1	-	3	3	-	7	9	-	-	-	-	-	-	-	2	3	-	-	-	0	13	16
91-95	-	1	1	-	2	2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0	4	4
96-100	-	1	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	-	-	-	0	2	3
101-105	-	-	-	-	2	2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	0	3	3
106-110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	0	1	1
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
TOTAL	3	87	91	28	72	109	15	82	105	4	14	24	33	12	50	23	6	50	35	0	50	141	273	479

* OCCASIONAL DISCREPANCY IN COLUMN ADDITION DUE TO SCALE REGENERATION.

APPENDIX 7c. LENGTH FREQUENCY DISTRIBUTION BY AGE (0+ AND 1+) OF COHO JUVENILES MINNOW TRAPPED IN NORTH BOISE CREEK, AUGUST-NOVEMBER 1980.*

DATE:	AUG 6			AUG 14			AUG 20			SEP 3			SEP 11			SEP 23		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
36-40	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
41-45	1	-	1	5	-	5	9	-	9	5	-	7	9	-	9	1	-	1
46-50	-	-	-	4	-	4	3	1	6	21	-	21	12	-	13	1	-	1
51-55	-	-	-	3	-	3	4	-	4	9	-	9	8	-	8	9	-	9
56-60	2	-	2	1	1	2	3	1	4	3	-	3	6	-	7	12	-	12
61-65	-	1	2	-	3	3	-	5	5	1	3	4	2	1	3	7	1	8
66-70	-	8	10	-	7	7	1	5	7	-	-	1	-	3	3	-	2	3
71-75	-	6	9	-	11	11	-	6	6	-	3	3	-	2	2	3	1	4
76-80	-	8	12	-	7	7	1	3	4	-	2	2	-	2	2	1	4	5
81-85	-	7	7	-	5	5	-	1	1	-	-	-	-	2	2	1	2	3
86-90	-	2	5	-	2	2	-	-	-	-	-	-	-	-	-	-	3	3
91-95	-	1	1	-	1	1	-	1	1	-	-	-	-	1	1	-	-	-
96-100	-	1	1	-	-	-	-	1	1	-	-	-	-	-	-	-	1	1
101-105	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
106-110	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	3	34	50	13	37	50	21	25	50	39	8	50	37	11	50	35	14	50

* OCCASIONAL DISCREPANCY IN COLUMN ADDITION DUE TO SCALE REGENERATION.

CONTINUED

APPENDIX 7c. (CON'T).

DATE:	OCT 1			OCT 15			OCT 22			NOV 19			TOTAL		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)															
36-40	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1
41-45	-	-	-	1	-	2	-	-	-	-	-	-	31	0	34
46-50	2	-	2	9	-	9	3	-	4	-	-	-	55	1	60
51-55	6	-	9	12	-	12	7	-	7	1	-	1	59	0	62
56-60	8	-	11	3	-	5	11	-	11	1	-	2	50	2	59
61-65	3	1	9	6	1	7	8	-	9	3	1	4	30	17	54
66-70	2	-	2	3	-	3	4	1	5	2	5	7	12	31	48
71-75	-	-	3	2	-	3	2	2	4	1	3	4	8	34	49
76-80	-	3	5	-	5	5	-	3	3	1	8	9	3	45	54
81-85	-	6	6	-	-	-	-	3	5	-	7	8	1	33	37
86-90	-	1	1	-	1	2	-	1	1	-	4	5	0	14	19
91-95	-	-	1	-	1	2	-	-	1	-	5	5	0	10	13
96-100	-	-	1	-	-	-	-	-	-	-	3	3	0	6	7
101-105	-	-	-	-	-	-	-	-	-	-	2	2	0	3	3
106-110	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
111-115	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
116-120	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
TOTAL	21	11	50	36	8	50	35	10	50	9	38	50	249	196	500

APPENDIX 8a. TRAPPING EFFORT AND CATCH RESULTS FOR SLOUGH CREEK, 1979 AND 1980.

YEAR	DATE	NO. TRAPS	HOURS SET	COHO CATCH			SAMPLE RESULTS: AGE		SAMPLE RESULTS: % MARKED		ESTIMATED MEAN CATCH PER TRAP		
				MARKED	UNMARKED	TOTAL	0+	1+	0+	1+	TOTAL	AGE 0+	AGE 1+
1979	AUG 2	4	24	-	196	196	29	40	0.00	0.00	49.00	20.59	28.41
	AUG 16	4	24	-	151	151	22	23	0.00	0.00	37.75	16.46	19.29
	SEP 7	2	12	-	126	126	18	26	0.00	0.00	63.00	25.77	37.23
	SEP 13	2	12	-	74	74	18	22	0.00	0.00	37.00	16.65	20.35
	OCT 5	3	30	14	131	145	33	13	0.00	0.00	48.33	34.67	13.66
	OCT 11	2	3	114	41	155	42	5	80.95	100.00	77.50	69.26	8.24
	OCT 20	2	12	152	113	265	31	8	54.84	100.00	132.50	105.32	27.18
	NOV 14	2	5	20	24	44	36	3	44.44	66.67	22.00	20.31	1.69
	TOTAL	-	-	300	660	960	200	100	61.47**	93.75**	56.47	37.65	18.82
1980	AUG 6	2	6	24	98	122	18	20	0.00	25.00	61.00	28.89	32.11
	AUG 14	2	6	19	289	308	32	17	0.00	17.65	154.00	100.57	53.43
	AUG 20	2	5	25	189	214	31	17	0.00	35.29	107.00	69.10	37.90
	SEP 4	2	24	19	116	135	18	28	0.00	32.14	67.50	26.41	41.09
	SEP 11	2	24	15	154	169	21	27	0.00	29.63	84.50	36.97	47.53
	SEP 23	2	24	6	64	70	32	17	0.00	11.76	35.00	22.86	12.14
	OCT 7	2	24	62	72	134	38	5	13.16	80.00	67.00	59.21	7.79
	OCT 15	2	24	19	24	43	28	9	25.00	77.78	21.50	16.27	5.23
	OCT 22	2	18	40	55	95	35	12	34.29	83.33	47.50	35.37	12.13
	NOV 19	2	18	52	46	98	21	26	47.62	69.23	49.00	21.89	27.11
	TOTAL	-	-	281	1107	1388	274	178	0.00* 27.87**	26.19* 75.00**	69.40	42.07	27.33

* PRIOR TO FIRST RELEASE OF CWT'S THAT YEAR.
** AFTER FIRST RELEASE OF CWT S THAT YEAR.

APPENDIX 8b. LENGTH FREQUENCY DISTRIBUTION BY AGE (0+ AND 1+) OF COHO JUVENILES MINNOW TRAPPED IN SLOUGH CREEK, AUGUST TO NOVEMBER 1979.*

DATE:	AUG 2			AUG 16			SEP 7			SEP 13			OCT 4			OCT 11		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
36-40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41-45	2	-	2	2	-	2	-	-	-	-	-	1	1	-	2	5	-	5
46-50	4	-	4	14	-	14	-	-	-	2	-	2	5	-	5	6	-	6
51-55	12	-	12	4	-	4	10	-	11	3	-	5	6	-	6	11	-	11
56-60	10	-	11	6	-	6	3	-	3	8	-	9	9	-	9	8	-	9
61-65	1	2	3	-	-	-	2	-	2	5	-	5	5	-	5	8	-	10
66-70	-	11	11	-	6	8	3	1	5	-	1	1	6	-	6	3	-	3
71-75	-	19	22	-	7	8	-	5	5	-	5	6	-	2	2	1	-	1
76-80	-	6	6	-	8	11	-	11	12	-	8	10	-	5	6	-	4	4
81-85	-	3	3	-	2	2	-	7	8	-	5	5	-	3	3	-	1	1
86-90	-	-	-	-	-	1	-	-	1	-	2	4	-	3	3	-	-	-
91-95	-	-	-	-	-	-	-	2	3	-	1	1	-	-	-	-	-	-
96-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
106-110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	29	41	74	26	23	56	18	26	50	18	22	49	32	13	47	42	5	50

* OCCASIONAL DISCREPANCY IN COLUMN ADDITION DUE TO SCALE REGENERATION.

CONTINUED

APPENDIX 8b. (CONT'D).

DATE:	OCT 20			OCT 26			NOV 14			TOTAL		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)												
36-40	-	-	-	-	-	-	3	-	3	3	0	3
41-45	5	-	6	-	-	-	8	-	10	23	0	28
46-50	14	-	14	3	-	3	20	-	21	68	0	69
51-55	3	-	5	3	-	3	4	-	4	56	0	61
56-60	3	-	3	8	-	8	-	1	3	55	1	61
61-65	3	-	3	4	-	4	1	1	2	29	3	34
66-70	2	-	4	6	1	7	-	1	1	20	21	46
71-75	-	2	3	1	-	3	-	-	-	2	40	50
76-80	1	3	5	2	3	6	-	-	-	3	48	60
81-85	-	1	4	1	1	4	-	-	-	1	23	30
86-90	-	1	1	-	7	7	-	-	-	0	13	17
91-95	-	-	1	-	2	2	-	-	-	0	5	7
96-100	-	1	1	-	1	1	-	-	-	0	2	2
101-105	-	-	-	-	-	1	-	-	-	0	0	1
106-110	-	-	-	-	2	1	-	-	-	0	2	1
111-115	-	-	-	-	-	-	-	-	-	0	0	0
116-120	-	-	-	-	-	-	-	-	-	0	0	0
TOTAL	31	8	50	28	17	50	36	3	44	260	158	470

APPENDIX 8c. LENGTH FREQUENCY DISTRIBUTION BY AGE (0+ AND 1+) OF COHO JUVENILES MINNOW TRAPPED IN SLOUGH CREEK, AUGUST-NOVEMBER 1980.*

DATE:	AUG 6			AUG 14			AUG 20			SEP 4			SEP 11			SEP 23		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)																		
36-40	-	-	-	4	-	4	1	-	2	-	-	-	-	-	-	-	-	-
41-45	-	-	-	7	-	8	5	-	5	-	-	-	1	-	1	4	-	4
46-50	5	-	5	8	-	8	7	-	7	5	-	7	2	-	2	2	-	2
51-55	3	-	3	9	-	9	14	-	14	7	-	7	8	-	9	14	-	14
56-60	3	1	4	3	-	3	3	-	3	6	-	6	10	-	10	11	-	11
61-65	-	3	5	1	2	3	1	1	2	-	1	2	-	1	1	1	-	1
66-70	-	8	12	-	4	4	-	3	3	-	8	8	-	3	3	-	1	1
71-75	-	6	7	-	6	6	-	8	8	-	11	11	-	13	14	-	7	8
76-80	-	2	2	-	5	5	-	5	5	-	6	7	-	7	7	-	4	4
81-85	-	-	-	-	-	-	-	-	1	-	2	2	-	3	3	-	4	4
86-90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
91-95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
96-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
106-110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
111-115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	11	20	38	32	17	50	31	17	50	18	28	50	21	27	50	32	17	50

* OCCASIONAL DISCREPANCY IN COLUMN ADDITION DUE TO SCALE REGENERATION.

CONTINUED

APPENDIX 8c. (CON'T).

DATE:	OCT 6			OCT 15			OCT 22			NOV 19			TOTAL		
AGE:	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL	0+	1+	TOTAL
FORK LENGTH (MM)															
36-40	-	-	-	-	-	-	-	-	-	-	-	-	5	0	6
41-45	7	-	9	-	-	-	2	-	2	-	-	-	26	0	29
46-50	12	-	14	11	-	11	12	-	12	5	-	5	69	0	73
51-55	10	-	10	12	-	12	8	-	8	5	-	6	90	0	92
56-60	7	-	8	3	-	4	5	1	7	6	3	10	57	5	66
61-65	1	-	1	-	-	1	4	1	6	5	5	10	13	14	32
66-70	1	1	2	2	3	5	2	2	4	-	1	2	5	34	44
71-75	-	2	2	-	1	3	1	3	4	-	11	11	1	68	74
76-80	-	2	4	-	3	3	1	1	2	-	2	2	1	37	41
81-85	-	-	-	-	1	2	-	3	3	-	1	1	0	14	16
86-90	-	-	-	-	1	2	-	1	2	-	2	2	0	5	7
91-95	-	-	-	-	-	-	-	-	-	-	1	1	0	1	1
96-100	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
101-105	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
106-110	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
111-115	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
116-120	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
TOTAL	38	5	50	28	9	43	35	12	50	21	26	50	267	178	481

APPENDIX 9a. MEAN DAILY WATER TEMPERATURES IN THE UPPER PITT RIVER AT THE LOWER BRIDGE CROSSING (4 KM UPSTREAM), SEPTEMBER - NOVEMBER 1979 AND 1980.

DATE	TEMP (C) 1979	1980	DATE	TEMP (C) 1979	1980
SEP 3	-	10.3	OCT 5	8.9	10.0
4	-	10.4	6	9.1	9.9
5	-	10.0	7	9.2	9.9
6	-	10.5	8	9.2	9.7
7	-	11.5	9	8.8	8.2
8	-	10.5	10	9.0	8.1
9	-	10.5	11	8.8	-
10	-	10.5	12	8.7	-
11	9.0	10.4	13	8.6	8.0
12	9.2	10.9	14	8.9	7.9
13	9.3	-	15	8.7	7.5
14	9.4	10.4	16	8.5	7.1
15	9.5	10.3	17	8.2	7.5
16	9.5	10.2	18	7.7	8.3
17	9.4	9.6	19	7.6	8.5
18	9.4	9.0	20	7.9	9.3
19	9.5	9.4	21	7.8	9.0
20	9.0	9.4	22	7.9	-
21	9.2	9.3	23	8.0	-
22	9.1	9.0	24	7.9	-
23	9.3	9.5	25	8.0	-
24	-	10.4	26	8.2	-
25	9.7	9.8	27	8.1	-
26	9.2	9.9	28	8.0	-
27	8.8	10.1	29	7.9	-
28	8.7	9.8	30	7.8	-
29	-	9.8	31	7.8	-
30	-	9.5	NOV 1	-	-
OCT 1	9.1	9.0	2	7.8	-
2	8.9	9.2	3	7.9	-
3	8.8	9.8	15	4.0	-
4	8.7	10.0			

APPENDIX 9b. MEAN DAILY WATER TEMPERATURES IN NORTH BOISE CREEK, AUGUST - NOVEMBER 1979 AND 1980.

	TEMP (C)			TEMP (C)			TEMP (C)	
DATE	1979	1980	DATE	1979	1980	DATE	1979	1980
AUG 6	-	12.0	SEP 9	10.0	11.4	OCT 13	9.6	7.0
7	-	11.9	10	10.0	12.0	14	10.2	7.7
8	-	12.4	11	10.6	12.2	15	10.4	7.5
9	-	12.9	12	10.9	12.0	16	9.0	7.1
10	-	13.7	13	-	11.7	17	-	7.5
11	-	13.9	14	-	12.0	18	7.1	6.2
12	-	13.9	15	-	11.0	19	6.0	8.7
13	-	13.4	16	-	10.9	20	-	-
14	-	12.9	17	-	11.5	21	-	8.7
15	-	12.5	18	12.0	10.2	22	-	7.5
16	-	12.4	19	12.4	9.6	23	-	6.8
17	-	11.8	20	12.2	8.5	24	7.3	7.3
18	-	11.1	21	12.4	8.5	25	7.6	8.2
19	-	11.9	22	11.6	8.9	26	7.5	7.5
20	-	12.0	23	11.5	10.3	27	7.4	7.4
21	-	12.1	24	11.8	10.5	28	6.8	7.6
22	-	12.0	25	11.2	10.2	29	6.8	8.3
23	-	12.6	26	11.0	10.6	30	6.4	8.6
24	-	12.7	27	10.4	11.0	31	-	8.5
25	-	12.0	28	9.8	11.1	NOV 1	-	8.7
26	-	11.7	29	10.2	10.9	2	-	8.2
27	-	11.5	30	10.5	10.6	3	-	8.2
28	-	11.0	OCT 1	9.8	9.9	4	-	8.0
29	-	-	2	9.6	9.9	5	-	8.7
30	-	-	3	9.7	10.9	6	-	7.7
31	-	11.0	4	-	11.5	7	-	7.4
SEP 1	-	10.7	5	-	11.2	8	-	7.2
2	-	10.5	6	10.5	11.0	9	-	5.0
3	-	10.6	7	10.6	11.1	10	-	5.0
4	-	11.1	8	-	11.3	11	-	4.0
5	-	12.0	9	-	9.6	12	-	4.2
6	-	12.0	10	-	9.1	14	3.0	-
7	11.5	12.0	11	-	9.6			
8	11.0	10.9	12	10.2	9.0			

APPENDIX 9c. MEAN DAILY WATER TEMPERATURES IN SLOUGH CREEK, AUGUST - NOVEMBER, 1979 AND 1980.

	TEMP (C)			TEMP (C)			TEMP (C)	
DATE	1979	1980	DATE	1979	1980	DATE	1979	1980
AUG 6	-	12.8	SEP 9	-	10.2	OCT 13	8.2	9.5
7	-	12.5	10	-	10.8	14	9.2	8.7
8	-	12.6	11	10.5	9.9	15	9.2	8.5
9	-	12.8	12	9.6	10.5	16	8.7	8.2
10	-	13.4	13	9.8	10.6	17	-	8.4
11	-	12.8	14	10.5	10.8	18	-	8.7
12	-	13.0	15	10.5	10.9	19	-	8.9
13	-	12.3	16	10.5	10.3	20	8.8	8.9
14	-	12.3	17	10.0	10.4	21	-	9.6
15	-	11.4	18	-	9.9	22	7.7	8.4
16	-	11.6	19	11.5	10.5	23	9.2	7.8
17	-	12.1	20	10.0	10.8	24	9.0	8.0
18	-	12.0	21	9.5	10.5	25	-	8.5
19	-	11.7	22	-	10.3	26	9.2	8.5
20	-	11.7	23	-	10.4	27	9.0	8.2
21	-	11.7	24	-	10.5	28	8.7	8.2
22	-	11.6	25	10.0	10.5	29	8.5	8.4
23	-	11.6	26	-	10.4	30	-	8.4
24	-	11.5	27	-	10.5	31	-	8.5
25	-	11.9	28	-	11.1	NOV 1	-	9.5
26	-	11.4	29	9.3	11.9	2	-	9.5
27	-	11.4	30	10.3	11.7	3	-	9.2
28	-	11.5	OCT 1	10.5	11.3	4	-	9.3
29	-	11.6	2	9.6	10.9	5	-	9.1
30	-	11.3	3	8.7	11.1	6	-	9.3
31	-	11.4	4	8.7	10.9	7	-	9.0
SEP 1	-	11.3	5	9.5	10.7	8	-	9.0
2	-	11.0	6	8.9	10.5	9	-	8.8
3	-	11.1	7	9.7	10.5	10	-	8.4
4	-	11.6	8	-	10.2	11	-	7.5
5	-	11.0	9	8.7	9.5	12	-	6.9
6	-	11.0	10	9.0	9.5	14	5.0	-
7	-	11.2	11	8.5	9.5			
8	-	10.7	12	8.2	9.6			

APPENDIX 9d. MEAN DAILY WATER TEMPERATURES IN BLUE CREEK, AUGUST 14 - OCTOBER 20, 1980.

DATE	TEMP (C)	DATE	TEMP (C)	DATE	TEMP (C)
AUG 14	13.0	SEP 6	13.0	SEP 29	10.6
15	12.4	7	12.0	30	10.4
16	12.5	8	11.2	OCT 1	9.7
17	11.2	9	11.5	2	-
18	11.7	10	11.8	3	-
19	11.6	11	11.8	4	-
20	11.9	12	11.8	5	-
21	12.3	13	11.5	6	-
22	12.0	14	12.0	7	-
23	12.3	15	12.0	8	-
24	11.8	16	12.0	9	-
25	11.7	17	11.8	10	-
26	10.8	18	11.3	11	-
27	10.1	19	10.4	12	9.1
28	10.2	20	9.0	13	-
29	9.8	21	9.3	14	-
30	9.6	22	9.0	15	7.2
31	10.5	23	9.5	16	6.8
SEP 1	9.7	24	10.5	17	7.2
2	10.4	25	16.0	18	8.2
3	10.5	26	10.7	19	8.5
4	11.0	27	11.2	20	8.8
5	11.7	28	11.2		

APPENDIX 9e. MEAN WEEKLY WATER TEMPERATURES IN CORBOLD CREEK, 1961-1967, 1979 AND 1980.*

WEEK ENDING	TEMPERATURE (C) 1961-67	1979	1980	WEEK ENDING	TEMPERATURE (C) 1961-67	1979	1980
JAN 7	2.8	0.4	3.6	JULY 7	8.2	-	-
14	2.7	1.2	1.5	14	8.5	-	-
21	2.3	1.9	2.3	21	8.6	-	-
28	2.2	1.4	1.9	28	9.0	-	-
FEB 4	2.9	0.3	0.8	AUG 4	9.9	-	-
11	3.4	1.7	3.1	11	10.1	-	-
18	3.4	2.2	2.2	18	10.1	-	-
25	3.3	1.9	3.1	25	9.7	-	-
MAR 3	2.7	2.6	4.1	SEPT 1	9.0	-	-
10	3.1	2.9	3.1	8	8.9	-	8.9
17	3.3	3.6	2.5	15	8.7	9.3	8.9
24	3.4	3.7	3.3	22	8.5	9.0	8.6
31	3.8	3.6	3.5	29	8.5	8.7	9.0
APR 7	4.4	4.1	4.1	OCT 6	8.0	8.3	9.1
14	4.8	5.0	4.6	13	7.6	8.6	8.3
21	5.0	4.3	5.0	20	7.1	7.6	7.0
28	5.4	5.1	6.0	27	6.7	6.3	6.6
MAY 5	5.3	5.4	6.6	NOV 3	6.4	6.1	7.4
12	5.8	5.4	6.7	10	5.8	5.6	7.4
19	5.9	6.0	6.3	17	4.9	4.2	4.5
26	6.2	6.3	6.0	24	4.4	4.6	4.6
JUNE 2	6.6	6.3	6.7	DEC 1	3.9	3.3	3.9
9	6.7	-	-	8	4.1	4.4	1.6
16	7.1	-	-	15	3.1	3.6	3.1
23	7.4	-	-	22	3.2	3.9	4.3
30	7.3	-	-	29	2.8	4.0	4.5

* FROM IPSFC RECORDS

APPENDIX 10. MEAN WEEKLY WATER TEMPERATURES (C) IN THE UPPER PITT RIVER, NORTH BOISE CREEK, SLOUGH CREEK CORBOLD CREEK AND BLUE CREEK, SEPTEMBER - NOVEMBER 1979 AND 1980.

WEEK ENDING	UPPER PITT RIVER		N BOISE CREEK		SLOUGH CREEK		CORBOLD CREEK*		BLUE CREE
	1979	1980	1979	1980	1979	1980	1979	1980	1980
SEP 8	-	10.7	-	11.3	-	11.1	-	8.9	11.4
15	9.3	10.5	10.8	11.7	10.3	10.5	9.3	8.9	11.3
22	9.3	9.4	12.1	9.7	10.7	10.4	9.6	8.6	10.4
29	9.1	9.9	10.8	10.7	9.6	10.8	8.7	9.8	10.5
OCT 6	8.9	9.6	10.0	10.7	9.5	11.0	8.3	9.1	-
13	8.9	8.8	10.1	9.9	8.8	9.8	8.6	8.3	-
20	8.2	8.8	8.7	7.8	9.8	8.6	7.6	7.8	7.8
27	8.8	-	7.4	7.6	8.8	8.4	6.3	6.6	-
NOV 3	7.7	-	6.7	8.3	8.6	8.8	6.1	7.4	-

* FROM IPSFC RECORDS.

APPENDIX 11. MEAN DAILY STAFF GUAGE READINGS AT UPPER PITT RIVER BRIDGE AND LOWER NORTH BOISE CREEK, AUGUST - NOVEMBER 1979 AND 1980.

UPPER PITT RIVER									NORTH BOISE CREEK					
	GAUGE (M)			GAUGE (M)			GAUGE (M)			GAUGE (M)			GAUGE (M)	
DATE	1979	1980	DATE	1979	1980	DATE	1979	1980	DATE	1979	1980	DATE	1979	1980
AUG 31	-	1.75	SEP 29	1.93	3.54	OCT 30	1.71	-	SEP 4	-	0.14	OCT 5	0.20	0.21
14	-	1.98	30	1.99	2.46	31	1.59	-	5	-	-	6	0.20	0.21
20	-	1.77	OCT 1	1.77	2.08	NOV 1	1.48	-	6	-	0.12	7	0.19	0.20
31	-	1.45	2	1.62	1.82	2	1.45	-	7	-	0.26	8	0.18	0.20
SEP 2	-	2.03	3	1.58	-	14	1.14	-	8	-	0.16	9	0.17	0.18
3	-	1.75	4	1.57	1.72				9	-	-	10	0.18	0.18
4	-	1.52	5	1.58	1.65				10	-	0.10	11	0.17	0.17
5	3.75	1.55	6	1.71	1.74				11	0.34	0.09	12	0.17	0.22
6	2.67	1.71	7	1.68	1.71				12	0.30	-	13	0.16	0.44
7	2.26	2.04	8	1.66	1.75				13	0.28	0.07	14	0.17	-
8	-	1.77	9	1.64	1.49				14	0.27	-	15	0.14	0.21
9	-	1.62	10	1.72	1.39				15	0.26	-	16	0.20	0.17
10	2.33	1.58	11	1.66	1.36				16	0.26	-	17	0.23	0.14
11	2.06	1.65	12	1.66	1.69				17	0.24	-	18	0.22	-
12	1.94	1.52	13	1.64	1.83				18	0.23	-	19	0.26	0.12
13	1.92	1.52	14	1.72	-				19	0.23	0.15	20	0.24	0.47
14	2.06	1.61	15	1.56	1.31				20	0.23	0.96	21	0.22	0.22
15	2.08	1.58	16	1.52	1.25				21	0.23	0.41	22	0.58	0.22
16	2.26	-	17	1.56	1.22				22	0.21	0.27	23	0.77	-
17	1.88	-	18	1.52	-				23	0.19	0.22	24	0.51	-
18	1.98	-	19	1.47	1.17				24	0.19	-	25	2.13+	-
19	1.99	1.66	20	1.41	1.81				25	0.18	0.17			
20	1.94	2.62	21	1.35	1.49				26	0.19	0.15			
21	1.99	1.92	22	2.00	-				27	0.51	0.13			
22	1.76	1.65	23	2.30	-				28	0.38	0.43			
23	1.75	1.52	24	2.10	-				29	0.29	1.22+			
24	1.75	-	25	3.82	-				30	0.32	0.58			
25	1.73	1.39	26	3.50	-				OCT 1	0.27	0.39			
26	1.79	1.37	27	2.93	-				2	0.25	-			
27	2.22	1.40	28	2.19	-				3	0.23	-			
28	2.19	1.77	29	1.86	-				4	0.20	0.23			

+ GAUGE DESTROYED.

POOR
QUALITY
ORIGINAL